THURSDAY, AUGUST 6, 1896.

TRAVELS IN EASTERN AFRICA.

Through Jungle and Desert. Travels in Eastern Africa. By William Astor Chanler, A.M. (Harv.), F.R.C.S. 8vo. Pp. xiv + 535. With 85 illustrations and 2 maps. (London: Macmillan and Co., Ltd., 1896.)

BRITISH East Africa and the adjoining parts of Africa, which are included in the spheres of influence of Germany and Italy, consist of a series of zones which run approximately parallel to the coast. Along the shore of the Indian Ocean is the low narrow coastal plain. In the interior are the high grass plains of Masailand, the dense forests and plantations of Kikuyu and Mau, and the thickly populated and well-watered basin of the Nyanza. Between these fertile zones lies a broad tract of barren, sandy, scrub-covered plains, occupied only by herds of game which follow the rains across it, or by small colonies of people who live along the banks of the rivers, or on the tracts of lava that form oases in the desert. This barren Nyika offers few attractions for man or beast, and both native traders and European explorers have hastened over it by the easiest routes to the richer countries of the Central Basin. Hence although the region of the Victoria Nyanza has been fairly well explored since first visited by Speke, the country to the north of the available routes to it has been largely left unvisited. Teleki in 1888-89 followed the great rift valley northward to Lake Rudolf; while Piggott, Peters, Hobley, and others made known the main points in the topography of the Tana Valley. But to the north of the Tana, and to the east of the Rift Valley, was a vast region of which nothing was known, except what could be gathered from the rough records of various Arab and Suahili traders, whose itineraries had been published by New and Denhardt.

"Purely in the interest of science," Mr. Chanler organised an expedition to explore this unknown land. He was fortunate in securing Teleki's able assistant, Lieut. Ludwig von Höhnel, as his companion and cartographer, and also a servant who had previously accompanied the author in a journey to Kilima Njaro. The three Europeans landed at Lamu, and formed a camp on the mainland at Mkonumbi, where they devoted three months to the organisation of the expedition. Seldom did an expedition have fairer prospects of success. Time was apparently no object, and perhaps the fact that Mr. Chanler's second name is Astor, explains why he was in the same fortunate position in regard to money. The three Europeans were men of experience in African work; they had a magnificent equipment; they had enlisted a powerful force composed of seven Somali, twelve Soudanese, and 140 Zanzibari, while Pokomo canoemen and others were engaged as required. The trade goods and armament were as suitable as the best local authorities could suggest or money buy; and their train of baggage animals and flotilla of canoes were sufficient for taking to the head of the navigable part of the Tana stores enough to last for years. In September, 1892, the march began. After many troubles, owing to the unhealthiness of the country, quarrels between the Soudanese and Somali with the Zanzibari, leading to desertions, and the death of baggage animals, the whole expedition arrived at the British East Africa Company's deserted station at Hameye. The party followed up the Tana to the confluence with the Mackenzie River. They ascended its valley, expecting that it would be the Guaso Nyiro; they found, however, that its volume gradually lessened, and that the river rises from various sources in the Jombani Mountains. Some distance further north they reached the Guaso Nyiro, which flowed to the east. They followed it till it was lost in a vast swamp known as Lake Lorian, and thus it never reaches the Tana. This was the first of the two principal discoveries made by the expedition, and it is interesting to remark that it was reported by New, from native information, as early as 1874. Disappointed at finding Lake Lorian to be only a swamp, Chanler and von Höhnel returned to the reserve camp, which had been left under Galwin at Hameye, indulging in some fighting with the natives on the way. They had some clear views of Mount Kenya, the height of which Höhnel gives as 19,650 feet; my estimate having been 19,500 feet. They started north again and moved the reserve camp to the country of the Daitcho. Chanler and von Höhnel then set out in search of a tribe known as the Randile, in order to purchase camels with which to carry their goods across the deserts to the north. They found the Randile, but could not persuade the tribe to sell camels. The account of this tribe is the most important contribution made by the expedition to African geography. For years past there have been legends of a race of "White Galla," and the traditions have come from several quarters, all pointing to the country to the east of Lake Rudolf as their home. Chanler does not refer to these legends, though they are known to all readers of Rider Haggard's novel "Allan Quartermaine." His description of the people (pp. 311-322) is the most important thing in the book, and is especially valuable as it is a simple statement of facts, every line of which shows careful observation and accurate record. The author describes the people as having a "prevailing light colour straight hair, and blue eyes," while they practise a circumcision of the navel and other rites not known among either Somali or Galla. Unfortunately there are no portraits, and no skulls were collected. The language contained many Galla words and some Masai, while the Somali could make themselves understood to the Randile. The words common to these languages, however, may easily have been adopted, and the author gives no information as to the grammar or structure of the language. Hence it seems impossible to form any idea as to the relations of this tribe; they are neither Bantu nor Nilotic, and perhaps are not even Hamitic. It seems most probable that they are the reported "White Galla," and that they entered the country from Northern Africa. Mr. Chanler's account only serves to whet our appetite for more information about this remarkable tribe. It is greatly to be hoped that the next traveller who can possibly enter into communication with it, will bring back portraits, or preferably a skull, and also get some idea of the grammatical form of the language.

Having failed in the main purpose of the visit to this tribe, Mr. Chanler returned on his tracks to the reserve camp in Daitcho, and thence marched west to join von Höhnel

at the southern end of the Loroghi mountains. The intention was to go westward to search for another tribe from which to buy transport animals. Sayer was reached, and some guides belonging to a tribe designated by a name which is no name—Wanderobbo—were secured. The country was in famine, and the Wanderobbo were starving. They begged Chanler to kill them some food, and he and von Höhnel spent some days shooting elephant, during which the author had several extraordinary escapes. He was preparing to start westward, when von Höhnel was knocked over by a rhinoceros and seriously injured. He was carried back to Daitcho, and thence sent to the coast. From this time the story of the expedition is a catalogue of disasters. All the camels had long since been dead, and most of the repeated relays of donkeys had suffered the same fate. Galwin was sent back to Ukamba to buy more of the latter. The Tana rose in flood, and for months the two halves of the expedition were separated; meanwhile the remaining donkeys were dying, and the rainy season, during which alone it was possible to cross the northern deserts, was being spent in enforced idleness. Then the Zanzibari suddenly mutinied and marched in a body to the coast. Soon after this the Soudanese, frightened by some preparations for the arrest of any Zanzibari who might be found, also bolted. The author had to destroy his stores, worth 9000 dollars, and return to the coast, which he reached at Mombasa after an absence of sixteen months.

The last pages of the volume contain the story of quarrels with the authorities at Zanzibar in regard to the treatment to be given to Chanler's deserters, who had been detained in Zanzibar. The author is very severe in his condemnations of the Zanzibar and British authorities. He declares that they suggested and instigated the mutiny, or at least gave the leader "something stronger than a hint" (p. 466); and on Mr. Chanler's return to Zanzibar, he was unable to obtain any assistance from them in securing the punishment of his men. The Prime Minister of Zanzibar, Sir Lloyd Matthews, held that the porters were justified in their desertion, and instead of punishing them, demanded from Mr. Chanler the full amount of pay due to them—a demand with which the author refused to comply. The question is an important one, but it is unnecessary to discuss it here. Mr. Chanler is naturally angry with the men whose desertion ruined his plans, and with the authorities who subsequently believed their story and took their part. Mr. Chanler admits that he has no very satisfactory theory of his men's desertion, which took him quite by surprise; or why the Zanzibar authorities should have urged his headman, Hamidi, to organise the revolt. But no one who knows General Matthews, and his readiness to help the traveller of any nationality who applies to him, will credit the charges made against him.

It is a pleasure to turn from the sad story of foiled plans, wasted chances, and angry accusations, to consider the value of Mr. Chanler's work, which represents a substantial addition to our knowledge of British East African geography. The author's text and Lieut. von Höhnel's magnificent map (which unfortunately often differ greatly in the spelling of the place-names) are contributions to the knowledge of British territories for which English naturalists and administrators must be grateful. Mr. Chanler has given us a map of an unknown region, discovered a most remarkable and interesting tribe, solved an important geographical problem, and made valuable scientific collections. He achieved these results by a generous expenditure of time and money, and at the cost of great personal hazard and hardship; and if he did not carry out the whole of the ambitious scheme at which he aimed, he displayed magnificent perseverance and courage in trying time after time, by route after route, to traverse the barren desert before him.

We cannot, however, but regret that Mr. Chanler's journey involved considerable bloodshed, and that the spirit with which he regarded this, may be gauged by his remark (p. 329), "I could not permit myself to indulge in the pleasure of an attack," although "the temptation to yield [to the entreaties of his men to seize the rich herds of a tribe with whom he had contracted the rite of blood-brotherhood] was, I must admit, next to impossible."

J. W. GREGORY.

APOLLONIUS OF PERGA.

Apollonius of Perga: Treatise on Conic Sections. Edited in Modern Notation, with Introductions, including an Essay on the Earlier History of the Subject, by T. L. Heath, M.A. Pp. clxx + 254. (Cambridge: at the University Press, 1896).

THE assertion made in the opening lines of the preface to the book now before us, that "to the great majority of mathematicians at the present time, Apollonius is nothing more than a name and his "Conics," for all practical purposes, a book unknown," is probably well within the truth. That this should be so is a pity, because the work of the great geometer is not only valuable and interesting in itself, but affords an excellent example of the methods of Greek geometry at its best period.

Nevertheless it must be admitted that this state of things is not altogether surprising. To read through the "Conics," say in Halley's folio edition, requires not a little courage and perseverance. A modern geometrician, approaching the text for the first time, cannot fail to be struck, and is in most cases repelled, by the curious combination of crabbedness and diffuseness which it appears to present. On the one hand the nomenclature is really very concise, almost as much so, in fact, as the quasi-algebraical notation at present in vogue; on the other, there is an elaborate array of general enunciation, particular enunciation, distinction of cases, construction analysis, synthesis, and conclusion—all in strict accordance with the logical scheme which had become orthodox long before Apollonius's time. Formal demonstrations are given of propositions which we should be apt to dismiss as intuitively evident, and a preference is shown for indirect methods of proof which, in some cases, almost amounts to perversity.

Besides this, the reader who wishes to appreciate the "Conics" has to overcome a real and serious difficulty arising from the peculiar form in which the argument is presented. The Greeks elaborated the methods of geometrical proportion and the application of areas until they possessed an engine which, in capable hands, is, up to a certain point, as effective as the methods of modern

analytical geometry. In fact, a considerable part of Apollonius's treatise is coordinate geometry pure and simple; but it is expressed throughout in a strictly geometrical form. This is not without its advantages, both theoretical and practical: it avoids the thorny question of the continuity of numerical quantity, and it compels the reader to realise the meaning of every step that is taken. It is not unlikely that a well-trained Greek mathematician could follow the geometrical demonstrations as easily as the modern analyst can assimilate the corresponding algebraical proofs; it is anything but easy for one who has been brought up on the system now current to familiarise himself with the methods and points of view which prevailed in the age of the Ptolemies.

Still the labour is well worth undertaking, and Mr. Heath's edition will do much to lighten it. It may be well to state at once that the book will not relieve the serious student of the duty of consulting the original text. The editor, after performing the laborious task of literally translating the whole treatise, decided, very wisely, we think, not to publish it in that form. Instead of this, he has recast it into a form similar to that employed in most text-books on geometrical conics; he has occasionally condensed several propositions into one, made some slight rearrangements of order, and omitted, or merely given an abstract of, a certain number of propositions which are either of slight importance, or indirect proofs of converses by the usual *reductio ad absurdum.*

The result is that the English reader has before him the substance of Apollonius's great work, in a notation with which he is himself familiar, while at the same time he may, with a slight effort, read it back into the geometrical form of the original. In this sense it deserves to be called an edition, and is not a mere caricature tricked out with modern "improvements." Apart from the notation, the book really gives a trustworthy presentation of the contents and method of the original; the amount of alteration which the actual text has undergone may be estimated by the literal transcripts of Book III. Prop. 54, and Book II. Prop. 50 (one case), which will be found on pp. lxxxix–xciv of the Introduction. Some may object that the condensation is excessive; but we are inclined to think that this is not the case, when we consider the object which the editor had in view, namely to provide an edition "so entirely remodelled by the aid of accepted modern notation as to be thoroughly readable by any competent mathematician."

In this praiseworthy aim Mr. Heath has certainly succeeded, and it may be hoped that the "Conics" will now attract the attention which it undoubtedly deserves. The more the treatise is examined, the more evident become its power and comprehensiveness. Apollonius begins by considering any plane section of a circular cone, not necessarily right, and at once obtains a result equivalent to the equations of the parabola, ellipse and hyperbola in the forms

$$y^2 = px, \quad y^2 = px \pm \frac{p}{d}x^2$$

referred to a diameter and the tangent at one end of it; p being the parameter, and d the corresponding diameter. It is to be observed that, in the first instance, Apollonius speaks of *the* diameter, namely the particular one associated with the axial triangle of the cone. He then goes on to prove the existence of a conjugate diameter, and shows that any chord through the centre is bisected there; then, after a discussion of tangents, comes a very remarkable section, in which the transition is made from the original diameter and the tangent at one end of it to any other diameter and corresponding tangent. Every one is more or less aware of the fact that Apollonius practically solved the problem of drawing normals to a conic from any point in its plane; it is perhaps hardly so well known that he was acquainted with many of the focal properties of central conics, with the auxiliary circle, and with the harmonic properties of poles and polars. Oddly enough, the focus-directrix property of a conic does not appear, and was apparently unknown to Apollonius; the directrix is never used or mentioned, and the foci of a central conic are obtained by a construction equivalent to $AS.SA^1 = CB^2$. For this reason, no doubt, the focus of a parabola is not used or mentioned. But, with this one exception, almost all the principal theorems of ordinary geometrical conics are to be found in this treatise, composed more than twenty-one centuries ago.

The text of Mr. Heath's edition is preceded by a very valuable introduction, in which will be found an excellent account of the earlier history of conic sections among the Greeks, followed by an instructive essay on the characteristics and methods of Apollonius. This, with the appendix on the terminology of Greek geometry, will be of great service to those who may feel attracted towards research in the history of mathematics; a subject not interesting to many, but fascinating to the few who combine the instinct of an antiquarian with the necessary linguistic knowledge and mathematical ability.

One or two suggestions may perhaps be made in anticipation of another edition. A glossary of Greek technical terms, or at any rate an index of them, with references to the pages of the introduction where they are explained, would be a useful addition. The figures, on the whole, are clear, but some of them might be more accurately drawn; and in some of the longer and more difficult propositions it is very inconvenient to have to turn back to look at a figure on a previous page.

G. B. M.

THE HARE, FROM THE FIELD TO THE TABLE.

Fur and Feather Series.—The Hare. Edited by A. E. T. Watson. 12mo. Pp. 263. Illustrated. (London: Longmans, Green, and Co., 1896.)

FROM the first it was evident that the beautifully illustrated volumes of the "Fur and Feather Series" would appeal more to the sportsman and the *bon-vivant* than to the naturalist. That this is the case with the present issue may be inferred from the fact that out of a total of 263 pages, only a paltry sixty-two are devoted to what the author calls the natural history of the hare. As a matter of fact, it is impossible to apply the term "natural history" to the subject of more than the first forty-eight pages; the third chapter in Mr. Macpherson's

section of the work being devoted to the legislation concerning the animal in question, while the fourth bears the mysterious title of "The Hare and her Trod." From reading the text, we infer that "trod" has something to do with poaching, although of its precise signification we are still in ignorance.

In the preface to the series the editor makes it to be understood that the natural history of the animals forming the subjects of the different volumes will be treated somewhat fully. We are, however, very doubtful whether the more or less discursive gossip communicated by Mr. Macpherson is entitled to be regarded as natural history at all. There exist, it may be remembered, as models for popular monographs of any particular animal, the little volume on "The Horse," by Sir W. H. Flower, and the more pretentious work of Prof. Mivart on "The Cat"; and the author would, we think, have done well to have followed somewhat on those lines. Instead of having done this, we are not even told that the hare is a rodent, much less do we learn anything about its relatives of the same genus, and the points in which these latter differ. Beyond a few observations as to its occurrence in the different counties of Britain, and certain variations in colour and size assumed by the animal in some European countries, we are left absolutely in the dark as to the geographical range of the common hare—a subject which well merits full consideration in a work of this nature. Throughout the first chapter we find no mention of either the generic or specific names of the hare; a matter which might be passed without comment, were it not that on page 12 both scientific names of an unimportant parasite are introduced without any possible advantage. When, however, we reach page 30, we find mention for the first time of the genus *Lepus* in connection with two American species; the reader—if not a naturalist—being left to find out for himself whether the common hare is or is not a member of the same genus. What might be the aforesaid uninstructed reader's view as to the zoological position of the rabbit, we dare not hazard a guess!

Such observations as are given on the natural history of the hare, appear to relate chiefly to its breeding habits, its marvellous speed, and the depredations it commits on farm and garden crops. Although doubtless accurate enough in this way, they are very far from forming anything like a complete history of the animal, and are too discursive for our own taste, even in a popular book. Nothing in the way of new facts appears to be given, although this may well be excused.

As may be inferred from what we have written, the whole of the natural history portion of the work is from the pen of Mr. Macpherson. Several authors—among whom may be named the Hon. G. Lascelles and Mr. C. Richardson—are, however, responsible for the sporting sections; whi e the chapter on cookery has been written by Colonel K. Herbert. Whatever may be its shortcomings from a zoological point of view, the work, so far as we can judge, from the sporting aspect is in every way admirable, and it ought specially to become an invaluable companion to the country gentleman. The numerous fine illustrations make the volume excellent from an artistic point of view.

R. L.

OUR BOOK SHELF.

Grundriss einer Geschichte der Naturwissenschaften. Von Dr. Friedrich Dannemann. I. Band. Erläuterte Abschnitte aus der Werken hervorragender Naturforscher. Pp. xii + 375. (Leipzig: Wilhelm Engelmann, 1896.)

THE idea upon which this book is constructed is an admirable one. By means of extracts and translations from the writings of great philosophers and investigators, a panorama of scientific history is presented in a most attractive form. Beginning with Aristotle and his Natural History, the author passes before the reader in historical succession the works and thoughts of Archimedes, Copernicus, Galileo, Gilbert, Kepler, Newton, Huyghens, Laplace, Lavoisier, Blumenbach, Cuvier, Darwin, and the host of other great thinkers and workers, who have helped to build up the edifice of scientific knowledge. To do this, Ostwald's excellent series of "Klassiker der exakten Wissenschaften" have been largely utilised. But we hasten to remark that the present volume does not merely consist of extracts and illustrations from series of reprints. A biographical note precedes the story in which each investigator tells of his work, and helpful editorialnotes are distributed throughout the book.

The work will be completed in two volumes, and we look forward with pleasure to the publication of the second one. The best text-book is the one which brings the student into close contact with the investigator, and thus creates in him a spirit of emulation. Dr. Dannemann's volume shows how this kindred feeling can be developed; therefore we welcome it as a valuable addition to scientific literature.

The Biological Problem of To-day. Preformation or Epigenesis? The Basis of a Theory of Organic Development. By Prof. Dr. Oscar Hertwig. Authorised translation by P. Chalmers Mitchell, M.A. Pp. xix + 148. (London: William Heinemann, 1896.)

THE German edition of Dr. Hertwig's discursive treatise —"Präformation oder Epigenese?"—was so fully reviewed in these columns shortly after it appeared (vol. li. p. 265, 1895), that it is unnecessary to state again the criticism contained in it of Weismann's theory of the germplasm and doctrine of determinants, or to go over Dr. Hertwig's own theory of the development of organisms. The fact that this translation is an authorised one, and that it bears the name of Mr. Chalmers Mitchell, is a sufficient guarantee for biologists that the arguments set forth in the original edition are faithfully reproduced. In a lucid introduction, Mr. Chalmers Mitchell states the positions taken by Weismann and Hertwig, and points to the issue involved. This statement, and the glossary of technical terms, will be very helpful to readers who have but a general idea of the matters on which the argument turns. The German words "Erbgleich" and "Erbungleich," which Mr. Bourne proposed to translate isocleronomic and anisocleronomic, have been rendered by the words "doubling" and "differentiating." The word "rudiment" has been used as the equivalent of "Anlage," and most biologists will agree that it well covers the meaning of the German word.

Every one interested in the problems of heredity will be grateful for this translation of a very important treatise.

The X-Rays. By Arthur Thornton, M.A. Pp. 63. 25 illustrations. (Bradford: Percy Lund and Co., Ltd. 1896.)

THIS slender brochure contains a general statement of the nature of sound, light, electrical vibrations, and electrical discharges through gases, together with brief instructions for observing and photographing Röntgen phenomena, and an explanation of the theories concerning the nature of Röntgen rays. For readers desirous of obtaining an idea of the prominent features of Röntgen's discovery, the book may be recommended.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Sun-spots and Faculæ.

THE following account of the nature of sun-spots and of the faculæ commonly found associated with them, explains these phenomena by refraction through the sun's atmosphere on the supposition that the centre of a spot is the centre of a high-pressure area or anticyclone.

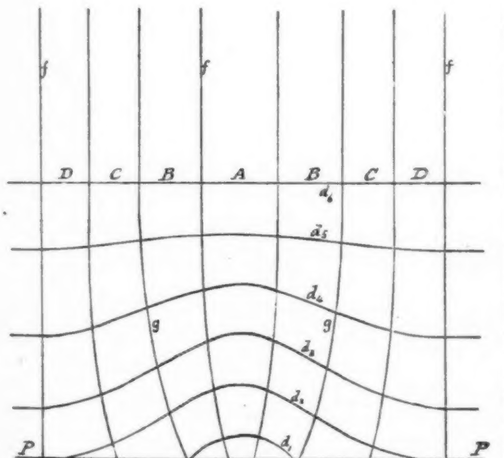
The descending central current in a solar anticyclone is caused by the exterior portion of the sun's atmosphere being at a temperature less than is consistent with convective equilibrium; consequently the whole of the descending column is colder and heavier than the atmosphere at the same level outside the area affected. The result is that the density of the atmosphere near the *base* of the column is increased, as compared with the normal density at the same level, by three different causes, viz.:—

(1) By lower temperature.

(2) By greater pressure, resulting from the upper portion of the column being colder and heavier than the normal at the same level.

(3) By additional pressure, resulting from the downward motion of the column being arrested near the photosphere; hence the pressure at the base is increased by inertia.

In the diagram annexed (a supposed section through the sun's atmosphere at a high-pressure area), the surface of the photosphere is represented by the line P P, and the successive surfaces



of equal density in the atmosphere are represented by the lines d_1, d_2, &c. These surfaces, indicating greater density in the centre of the area affected, must be convex-outwards in the centre, and concave-outwards near the margin, where they join with horizontal equal-density surfaces in the undisturbed atmosphere outside the anticyclonic action.

The area in question is seen from a distant point in the direction of E by the rays of light which emerge from the atmosphere in approximately parallel lines, represented in the diagram by the lines *fff*. These rays before emerging must pass through the atmosphere by such courses as those represented in the diagram; that is to say, as they cross successive equal-density surfaces, moving as they do from a greater density to a less, they are refracted in a direction *less* perpendicular to these surfaces. The greatest deflection will occur about the positions of the lines *g g*, which cross the surfaces where these are most inclined to the photosphere. The areas A and B B will thus appear dark because they are seen by the light from smaller areas of photosphere, *a* and *b b*. As drawn in the figure the circular area, A, is nine times the area *a*, and consequently its mean brightness would be only one-ninth normal brightness; and the annular area, B B, being three times the area *b b*, would appear one-third normal brightness.

Beyond the greatest deflection lines, *g g*, the annular area on the photosphere is of greater width and less diameter than the corresponding annular area at the surface of the atmosphere. As drawn in the figure, the annular area, C C, is equal to *c c*, and would appear of normal brightness; while the area, D D, is about two-thirds of *d d*, and would appear of one and a half times normal brightness. In this region one or more faculæ would be seen surrounding the spot; one only if the concave-outwards curves of the equal-density surfaces were superposed one on another, as in the diagram; while if some series of such curves extended beyond others, more faculæ would be seen.

The occurrence of "eruptive prominences" near (but not at) the position where a spot has disappeared on the margin of the sun, is accordant with an anticyclonic motion round the spot; for this motion premises a rising-up of the lower atmosphere in the outer portion of the area affected. So also the greater width of the absorption-lines of the solar spectrum over a sun-spot, indicating that the absorbing atmosphere is there of greater pressure, is accordant with the theory here advanced.

It should be noticed that the brightness of the surrounding faculæ according to this theory arises simply from the light in which the spot is deficient. JAMES RENTON.

Observatorio Nacional, Cordoba, Argentine Republic.

Sailing Flight.

IN NATURE, May 14, p. 25, you have a notice of two works on flight of birds, and I am rather surprised to see that the theory of upward currents in the air is still adhered to.

In NATURE, November 4, 1880, I laid a few remarks before you on this subject, aided by a little diagram, and on re-perusing this can see little to add to them, and nothing to alter.

It seems to me that upward currents of air, to account for sailing flight of birds, is, firstly, quite needless; secondly, they cannot be seen or proved to exist; and thirdly, the entire absence of such currents can be (at least out here) optically demonstrated.

As stated in my note (November 4, 1880), above referred to, we have two steady winds out here, from N.E. and S.W.; they are not at all violent or gusty—indeed, if directed vertically they could not possibly lift and sustain a 20 lb. cyrus or pelican.

But the utter absence of vertical air currents in our N.W. wind, at the very time the large birds are soaring in it, is beautifully demonstrated by the tufts of cotton, blown from the burst pods of the tall cotton trees, *Bombax malabaricum*.

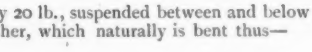
For many years I have had a rather large telescope, through which to study the Noga Hill villages and cultivation, at six to thirty miles south, and for long was puzzled by the frequent appearance of small white objects, which slowly crossed the field, horizontally, at all distances and elevations, and at a speed of about ten or fifteen miles per hour. At last I found they were cotton tufts, out of which the little seed had dropped, and the beautifully steady and horizontal paths of thousands, at all distances, was often remarkable, at the time the birds were soaring. Anything approaching vertical air currents must have been at once detected, and easily visible. I have for hours watched the sailing, at 1000 and 2000 feet, of Cyrus, called here Korson (*Grus Antigoni*); Pelican, called here Dherra (*Pelicanus*); three Vultures, called here Hogren (*Gyps Inds.*), and two larger kinds; two adjutants, called here Bov Tokla (*Leptoptilus Argala* and *Nudifrons*); one jabiru, called here Telia Hareng.

Now, not one of these birds are ever seen sailing in a straight line, unless when descending. They cannot rise, or even sustain themselves, without flapping the wings, unless in a breeze, and when moving in a curve or spiral.

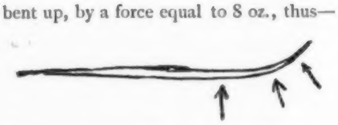
For the first 200 or 300 feet, in rising, they flap vigorously, and when well above the surface eddies, begin sailing in spirals, rising ten and twenty feet at each lap, wings held rigidly extended, and the tail alone seen to move now and then, and so on to 1000, 2000 and 3000 feet.

The primary feathers are each *widely* separated, thus giving a superposed aëroplane, at the wing extremities—

the body, say 20 lb., suspended between and below them. Each primary feather, which naturally is bent thus—



is strongly bent up, by a force equal to 8 oz., thus—

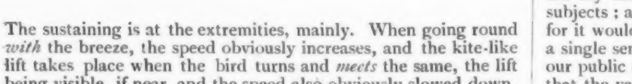


The sustaining is at the extremities, mainly. When going round *with* the breeze, the speed obviously increases, and the kite-like lift takes place when the bird turns and *meets* the same, the lift being visible, if near, and the speed also obviously slowed down.

But the drift of the rising spiral is to leeward. Varying *momentum* (of bird) in the resisting medium, must be noted; a stuffed albatross, or aëroplane, hung in a draught, will not solve the rising riddle.

The wing-plane for the moment is always part of a *cone*, outer wing highest.

When pelican travel for great distances in a straight line, their flight is at times peculiar, and they fly following each other, each bird alternating flaps or sails, thus—



the line of birds a series of waves. Our large hornbills, *Buceros bicornis*, behave in the same way.

I believe that when we look up and see a crowd of very minute specks some 5000 to 8000 feet above us (binoculars often needed), we see birds which have gone up there for coolness, and to go to *sleep*—to doze, at any rate. There is an entire absence of the mental and physical alertness and agility, which would be *constantly* needed if they depended on inequalities of wind pressure, and equally sudden, and invisible, *up gusts*, to save themselves from falling.

Herr Lilienthal is probably on the right trail. I see he desires to turn and meet the breeze; but in this movement, I fancy the upper central aëroplane—so high above the centre of gravity—will turn him over in a strong wind. In the bird's case (when turning) there is very obviously strong centripetal counter pressure, and great speed, quite sixty miles an hour I should suppose, at end of the leeward lap.

I notice that "W. J. S. L." (second paragraph, p. 301, January 30) assumes that the speed at times would be *slower* than the wind. This could only be when stopping. In the bird's case, the lifting is mainly done when it turns and meets the wind, and speed is slowed down, and the overturning is prevented, when the wings are thus, to the wind, by the great *lateral* expanse. There is none of this latter, in the centrally superposed plane machine; the bird's great lateral steadiness is structurally absent.

Soaring machines may be of two types: A, those *containing* their own power; and B, those deriving it from the surroundings only. There is no screw in the stern of the "Bov Tokla," as he wheels round and round close over me, as I sit hidden in a tuft of grass on the wide plain. Rising to windward, he circles over me at 200 feet or so, and with binoculars, or even without, I can see each feather, and hear the loud noise they make; there is never a move, except a little in the tail, yet lap by lap the bird steadily rises, and as steadily, if slowly, gets a drift to leeward.

I do not suppose the bird can soar without expenditure of energy; all I desire to point out is, that upward air currents do not lift and sustain it, also that the lifting is seen to be applied to the primary wing feathers almost entirely, and in a way which shows the lift is due to lateral translation. Tie a primary at the end of a long light stick, and on whirling it the effect is obvious.

S. E. PEAL.

Sibsagar, Asam, June 21.

The Position of Science at Oxford.

IT is notoriously difficult to express one's whole meaning in a condensed article. In so far as the article on the position of science at Oxford referred to the teaching of science at public schools, I see from Mr. C. I. Gardiner's letter that I have failed to express my meaning, and I must hasten to remove the impression that I intended to cast any reproach on the science masters of our public schools. I find it, indeed, difficult to understand how any one could have mistaken my meaning as much as Mr. Gardiner has done, seeing that I wrote that in every public school there are one or more science masters of tried capacity; a statement, I submit, which is entirely at variance with Mr. Gardiner's interpretation of my remarks. He makes me say that there is an absence of efficient teachers in scientific subjects; a statement which I never made, and could not make, for it would be manifestly untrue. I must admit, however, that a single sentence, "taken on the whole the science teaching at our public schools is bad," was unfortunate: I should have said that the value attached to science teaching at our public schools is altogether insufficient. Let me assure Mr. Gardiner that the last thing in the world that I should wish is that anything should be said or done to depreciate the attainments or the authority of science masters. Perhaps I may be allowed to explain. The efficiency of a machine depends firstly upon its excellence, secondly on the conditions under which it works. I do not dispute the excellence of science masters, but, speaking generally, I deplore the conditions under which they work in public schools. I stated that in public schools the inducements to learning science are very few (not nil, as Mr. Gardiner misquotes me); secondly, that it is openly discouraged; thirdly, that boys are apt to neglect studies which may safely be neglected. I adhere to each and all of these propositions. Boys, *pace* Mr. Gardiner, are as much impelled by emulation as by interest and fear (heaven forbid that fear of the cane should ever be associated with scientific teaching). Mr. Latter, in his valuable letter, throws the weight of his experience in favour of my statement: "A promising boy cannot make up by his science for deficiency in classics or mathematics . . . whereas the acute classic, however obtuse in science, is in no way hindered on his path to sixth form." No more need be said: the great inducement of emulation is wanting. If a boy neglects classics and mathematics he fails to rise in the school, is superannuated and sent away. If he neglects science, whilst working respectably at classics, he may incur formal reproof, he scarcely incurs reproach; at any rate he is in no danger of superannuation. Is it not safe, then, to neglect science? How Mr. Gardiner could have construed a harmless sentence into an attack on science teachers, I am at a loss to conceive. His conclusion is certainly not contained in the premisses, and I may be allowed to remind him that jumping to conclusions is hardly a scientific proceeding. As to the discouragement of science being no longer in existence, I can only say that Mr. Gardiner's experience is happier than mine. I trust his experience will soon become universal.

Boys do come to Oxford and to Cambridge destitute of scientific ideas. I have ample experience in Oxford, and my Cambridge friends make the same complaint. There are, of course, some few who have made science a speciality, and are well grounded, but the majority are absolutely ignorant of the alphabet of science. It is a well-known fact, and may be proved in the following way. Let it be proposed that a paper in rudimentary physics be compulsory in the "Little Go" at Cambridge, and in "Smalls" at Oxford. The proposal will be rejected by both Universities, because, it will be alleged, this minimal knowledge of science would be an insuperable barrier to the classical scholar. Moreover, it is the universal experience of those who are engaged in science teaching in the two Universities, that much of their energy is wasted in teaching the alphabet of science to those who propose to take honours in that subject. That alphabet might have been learned at school. I make no

reflection on the science masters. If the genius of the schools were something more than classical, if boys could get the same promotion for science that they do for classics, the opportunities of the science master would be increased a hundred-fold, and scientific knowledge would become the rule instead of the exception.

Throughout the article on the position of science at Oxford, I referred to public schools, only once to science masters, and that once in a complimentary sense. It should have been sufficiently clear, in spite of my unguarded sentence, that it was the spirit, the general scheme of education of our public schools, that I was attacking. Mr. Latter's letter justifies my attack. There are points in his letter which I would willingly discuss, but space forbids my entering into them now. As to the questions of Greek and the precedence of chemistry and physics over biology, there is much to be said on both sides. I will only say this: Mr. Latter is an accomplished zoologist, and his love of his subject perhaps leads him to under-estimate the intense interest which many young boys take in chemical and physical problems. After watching carefully a group of very small boys with whom I have familiar relations, I am convinced that they go after butterflies and fishes, not by preference, but because they have this opportunity of satisfying their thirst for natural knowledge, and have not the same opportunities for cultivating chemistry and physics. At any rate, if I offer to make hydrogen, or to exhibit an air-pump or an electric battery, the insects are deserted at once. Being a biologist myself, I write without prejudice in favour of the more exact sciences.

THE WRITER OF THE ARTICLE.

The Salaries of Science Demonstrators.

I FANCY the incident referred to in the fable quoted by "O. J. L." (p. 271) must have happened some time ago, possibly when "O. J. L." was a tadpole himself. I am sure he would not think so lightly of our grievances if he fully realised the state of affairs in this pond of late years. At one time every tadpole who did good work had a reasonable prospect of developing into a frog on attaining a suitable age. Now there are scores of tadpoles, some of them grey-haired, who attend meetings, and croak to the best of their ability, and read papers bearing the name of some frog as joint author, but who seem fated to end their days in the tadpole stage because they cannot get sufficient food to enable them to develop into frogs.

This state of affairs is, I take it, largely attributable to the following cause. As all naturalists are aware, our ponds at certain seasons of the year are choked with frog-spawn. Under the old *régime* this spawn had to take its chance; some got dried up in the sun, and some got washed away by rain, so that only one occasional *ovum* here or there hatched. This process of survival of the fittest led to the production of a race of frogs eminently adapted to hold their own in the struggle for existence, and many of these have now acquired world-wide reputations. But Mother Carey, fearing lest any of the eggs that perished might contain the latent germs of some remarkable genius, has carefully tended this frog-spawn and hatched it in a laboratory fitted up with all the most modern incubators and other appliances, and has sometimes even nurtured it with County Council and other scholarships. So far so good. But as soon as the tadpoles are hatched, Mother Carey turns them adrift into our pond to fish for themselves, and takes no more notice of them. The result is that, where we had one tadpole formerly, there are now hundreds, struggling and starving each other out. Every morsel of food dropped into our pond (even if it be only a matter of £60 a year) leads to a terrible scramble, in which the best of us do not always come off first. I consider that we have a genuine grievance against Mother Carey on the ground that, after having devoted so much energy to hatching large numbers of tadpoles annually, she gives so little thought about finding us proper food at the time when we most need it. If we cannot all live on dry land, let us, at any rate, have a fair chance of developing our power of swimming like frogs in the water.

"AN AGGRIEVED TADPOLE."

The Date of the Glacial Period.

MR. DAVISON has laid geologists under many obligations to him for his mathematical investigations of vexed or obscure questions. His suggestion in the *Geological Magazine*, that the glacial period would probably have left a long-enduring mark upon the iso-geotherms, seemed to me, as I dare say it did to other students of glacial geology, a promising one; and though a comparison, which I made of the gradients in thirty-seven cases within the glaciated area of Britain with sixteen in the unglaciated portion, failed to reveal any significant difference, still I have been disposed to ascribe the failure rather to the imperfection of the data than to any fault in the method. When, however, Mr. Davison (NATURE, June 11, p. 137) extends the application of his formula to a comparison of two hemispheres, the insufficiency of the data is such as to entirely vitiate any results.

In the northern hemisphere there were available in 1885, when Prestwich wrote his memoir published by the Royal Society, 231 series of observations on the temperature of mines, tunnels and bore-holes, and it was only by what appeared to be the rather arbitrary elimination of an immense number of the records, that anything like an agreement could be obtained

What, however, is the body of evidence employed in the determination of the temperature-gradient in the southern hemisphere? One bore-hole in New South Wales! Whatever confidence we may feel in the care exercised by the observers, I cannot think that any general conclusions should be based upon this single series of observations.

There are several well-known bore-holes in the northern hemisphere in which the gradient is as far from the average given by Mr. Davison as is that of the Australian one, and, though various explanations were suggested, none was regarded as satisfactory. If Mr. Davison had referred to the Wheelton bore-hole in the 19th and 20th reports of the British Association Committee on underground temperatures, he would have found there a series of observations, made by a practised physicist, and repeated after an interval of a year under varied conditions, with practically identical results; yet here the increase of temperature was only *1° F. per 70 feet.* The St. Louis bore-hole, again, gave an average gradient of 88 feet; and though the result was regarded as erroneous, it was acknowledged that every care had been exercised, and no specific source of error could be suggested.

Taking all the circumstances into consideration, I think it will be generally conceded that, interesting as this Australian record may be, it throws no light whatever upon the vexed question of alternate glacial periods in the two hemispheres.

PERCY F. KENDALL.

Yorkshire College, Leeds, July 16.

TAXIDERMY AND MODELLING.[1]

THAT taxidermy has been almost an entirely neglected art is obvious to the least scientific visitor to even the best of our museums, when he regards the "deformed, distorted, and disproportioned" effigies that represent our commonest species. Every means, therefore, be it by example or precept, which will have the effect of impressing on the taxidermist the importance of his share in the exposition of natural history, and which will tend to raise what is at present little better than the knack of distending, more or less cleverly, the skins of animals with wool or shavings, to the science and art of where and why to "stuff" and reproduce, and how to pose, will be welcomed by all those who are responsible for instructing, by forms made up to simulate life, those desirous of becoming acquainted with the likeness and gait of animals which they have few or no opportunities of observing in a state of nature; and by those who turn aside to our museums to refresh their spirits with the sight of species which they have learned to love in the fields or in the sea.

The title of the work which heads this article is from the pen of Mr. Montagu Browne, the Curator of the Leicester Museum. That institution has obtained a considerable and deserved reputation for the excellence of many of its mounted groups, birds especially, as examples of the taxidermist's art, prepared by the skilled hands,

[1] "Artistic and Scientific Taxidermy and Modelling: a Manual of Instruction in the Methods of Preserving and Reproducing the Correct Form of all Natural Objects, including a chapter on the Modelling of Foliage." By Montagu Browne, F.G.S., F.Z.S., &c., Curator of the Leicester Corporation Museum and Art Gallery; author of "Practical Taxidermy," &c. With 22 full-page illustrations, and 11 in text. Pp. xii + 463. (London: Adam and Charles Black, 1896.)

we believe, of the curator himself. A work, therefore, on the subject in which he is an expert deserves attention. Taken as a whole, we may at once say, that its careful perusal will well repay the practical taxidermist and modeller, for he will find the book to be a very detailed guide to the more important methods of reproducing animals and plants for exhibition purposes. Curators of museums, even though they are neither taxidermists nor modellers, will derive many excellent suggestions from its pages.

The object of the work, the author informs us, is to pave the way for the "happy combination" of qualities which he thinks the taxidermist should possess. "The future and hope of taxidermy will be," he says, "the welding of the educated artist, designer, modeller, sculptor, biologist and naturalist; and the two last are by no means synonymous terms, as some might suppose. When this happens—and there is no reason why all these attributes should not be combined in one individual—taxidermy will become an exact science relieved as painting is at present by poetic inspirations." In this opinion Mr. Browne but supports what Dr. Shufeldt, whom he quotes, has written on the subject of the taxidermist's training. Such a concatenation of qualities in one person will, we fear, remain a dream of the future. Life is not long enough for one individual to master a series of professions each arduous enough in itself for most men. Indeed, we hardly desire such a "professor" of many callings. Knowledge is never useless, but in our opinion it appears unnecessary to insist that the taxidermist of the future shall possess a scientific training in biology, or should know more anatomy and osteology than may be gained in his apprenticeship, and by very careful observation of the bodies of the animals he has to deal with; for he has to reproduce only the external surfaces as affected by various attitudes, and whichever of these he desires to reproduce he will have noted in his preliminary study of his subject. He has but to copy faithfully—neither to create, nor to use the painter's "poetic inspirations."

Following a short account of the origin and progress of taxidermy, the succeeding seven chapters (some 290 pages) deal with the skinning and setting up of vertebrates, and the preserving of invertebrates, by various methods; and also their reproduction by casting and modelling in paper, glue, &c. On these subjects Mr. Browne writes with undoubted authority and wide experience, and his instructions and descriptions are, therefore, of the greatest value. Besides the processes and methods long known and widely practised, the author claims to describe "methods of taxidermy and modelling not yet published, most of which are indeed absolutely novel, and at present confined to the Leicester Museum"; specially noteworthy among them is the mounting of the skin, which is fully described, upon a model of the body in paper, a process which, though tedious and demanding much labour and care, will probably prove to be a great improvement on that involving a "mannikin." An illustration of a model in paper of a headless tiger, on which the skin is to be fitted, is, through the courtesy of the publishers, reproduced here (Fig. 1).

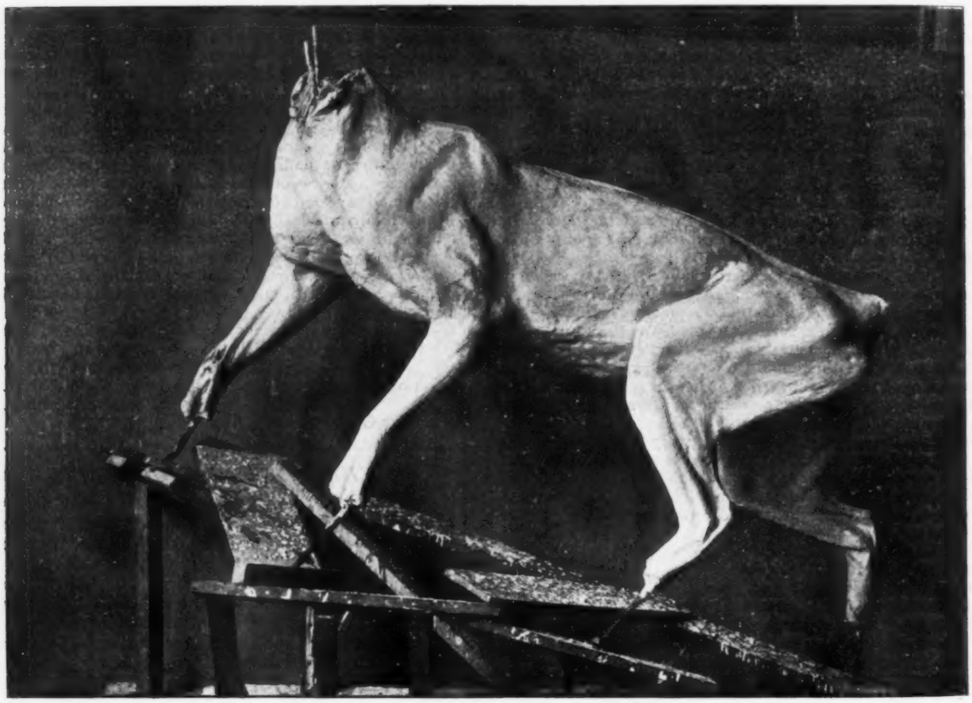


FIG. 1.—Model in Paper of the Headless Body of a Tiger.

We are surprised to observe that Mr. Browne strongly decries the use of "arsenical and mercurial [corrosive sublimate] soap," as being very inefficient and too dangerous for use, and recommends in its place "a non-poisonous preservative soap" (of chalk, lime-chloride and musk) of his own devising. Notwithstanding this, we read on page 35, "the most perfect preservatives are probably those which contain [which the author's preservative does not] with alcohol a certain percentage of bichloride of mercury," and on other pages several formulæ so com-

pounded are recommended for use for skins infested with insects, for it prevents insect pests and mildew "ever appearing afterwards." Great care is always necessary in the use of poisons; but as there is no greater danger in using arsenical soap containing bichloride of mercury than an alcoholic solution of the salt, we are at loss to understand his strong denunciation of the evidently more efficient medium. The present writer has found no preservative equal to it, and has used it for thousands of skins, bird and mammal, in various regions of the globe, and cannot recollect to have lost one by moth, mite, or dermestes—except when the soap was insufficiently applied. Many of them also, after lying for years as dry skins, have been relaxed, and have proved all that could be desired. The alcoholic solution of corrosive sublimate applied to a tender skin renders it very brittle, a result entirely obviated when the salt is incorporated in the soap. Several formulæ, of which Mr. Browne claims the authorship, are given for the preservation of cartilage; but we miss any reference, either in the book itself or in the bibliography at the end, to Prof. Jeffery Parker's methods. He was one of the first, if not the first, to preserve cartilaginous fishes as "dry" specimens in museums, by very similar, if not essentially the same, processes as Mr. Browne.

Not the least valuable section of the book is the ninth chapter, describing "casting and modelling from natural foliage, flowers, fruits, algæ, fungi, &c., and their reproduction in practically indestructible materials,"—the Mintorn Art Fabric. This is quite a recent branch of the taxidermist's art—if it really belong to it—which is as important, and demands equal care an ability as the mounting of the specimen which it is to enhance. The reproduction in this material of the species of the British flora in our museums would prove a very great incentive to the study of botany, which even the best prepared herbarium can scarcely be said to do. How naturally such plants can be modelled may be seen from the second plate (Fig. 2), which we are kindly permitted to reproduce. The volume, which is dedicated to the *doyen* of museum reformers, Sir William Flower, is so beautifully printed, illustrated and bound, that we feel we cannot close our commendation of the author's part without a word of appreciation of the publishers' share in its production.

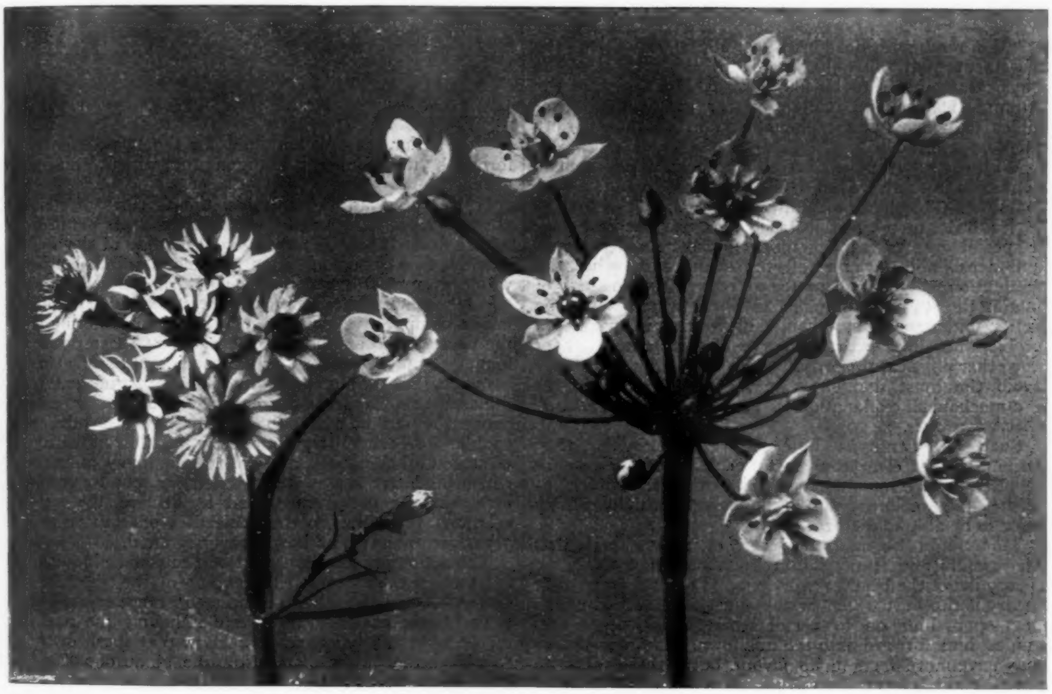


FIG. 2.—Models, in Fabric, of Sea-Aster and Flowering Rush.

PROGRESS IN STEREOCHEMISTRY.

TO the stronger minds among men of science, exercised in abstract conception, and independent of such aids to the imagination as are embodied in drawings of atomic arrangements, models of molecules and even formulæ of atomic groupings, there is no doubt something almost repulsive in the representation of the molecule as a machine, a combination of mechanical powers. It is nearly forty years since the screw was suggested (by Pasteur) as a symbol of the atomic arrangement in tartaric acid, and now we find the lever introduced in such phrases as "the moment of a chain of atoms varying with its length." The wheel-and-axle has not yet been pressed into the service to explain atomic vagaries; and of the philosopher who shall venture to take this further step, the abstract thinkers of to-day will surely say, as Kolbe said of the chemist who was destined to succeed him in his professorial chair at Leipzig: "Hereby he declares that he has left the ranks of men of science, and has gone over to the camp of those philosophers of ill-omen, who are separated from the spiritualists by only a very thin *medium!*"

Yet as surely as Kolbe was succeeded by the stereochemist whose doctrines he denounced, so surely will the

vague atomic groupings of to-day be succeeded by definite systems, in which each atom will have its orbit mapped out with ever-increasing minuteness; for as long as the atomic theory endures, so long will it become more and more of a mechanical theory; and indeed it would be absolutely inconsistent, when we are perpetually striving to arrange the atoms of a molecule into groups, to give up all attempt to determine the relative positions and motions of the groups and of the atoms within them. It is as true to-day as it was when Kekulé published the statement in his "Aims and Achievements of Scientific Chemistry," that as the great present aim of physics is the elaboration of a system of molecular mechanics, so the great present aim of chemistry is the elaboration of a system of atomic mechanics, in which every reaction will be accounted for by the mass and motion of the reacting atoms. This may be deplorable; but those who think it most so, most keenly realise that it is true.

For instance, quite recently, in his plea for "Emancipation from Scientific Materialism,"[1] Prof. Ostwald wrote:—

"We read and hear with countless repetition the statement that the only intelligent explanation of the physical world is to be found in a 'Mechanics of the Atoms'; matter and motion appear as the final principles to which natural phenomena in all their variety must be referred."

With regard to physics, a similar acknowledgment is contained in the words of Duhem, uttered in 1894:—

"When the science of motion ceases to be the first in logical order of the physical sciences, and becomes only a special case of a much more general science, which embraces in its formulæ all the changes of bodies, the temptation will be less to try to reduce to the study of motion the study of all physical phenomena; it will be better understood that change of position in space is a problem no simpler than change of temperature or of any other physical property. Then we shall more easily avoid the most dangerous reef of theoretical physics—a mechanical explanation of the universe." (*Jour. de Mathématiques*, x. 207.)

Such statements as these are valuable, in that they remind us that even the most necessary of our present theories is a temporary makeshift—a crutch which indicates the weakness that it helps, and which we may hope to be able to discard.

This might be said, however, of most things that are useful; and it must be remembered that the same theory is not the best for every one. For each man that theory is the best which is the most stimulating, which best spurs him on to useful work, which urges and guides him forward into the unknown. Another theory may have more facts in its favour, but if these facts do not specially interest the worker in question, it will be of less value to him than a theory, otherwise inferior, which enables him vividly to realise, and aptly to utilise, those facts which do interest him.

Moreover, even if we admit that the atomic theory may be near the end of its existence, and that it may, and should, shortly be superseded by a more widely useful theory, it must yet be maintained that the way to hasten this consummation is to push the theory with all rapidity, and in every direction, to its extreme consequences, in the full assurance that, so far as it is incomplete, this will be the quickest way to demonstrate its deficiencies.

Now, among the consequences of the atomic theory, the consideration of the space relations of the atoms occupies the first place; it is not an extreme, but an immediate and a necessary consequence. For this reason alone, if stereochemistry did not exist, it would be necessary to invent it. But to find a *raison d'être*, stereochemistry needs no such arguments. It has justified its existence by its achievements.

The stereochemical explanation of the existence and properties of the two different substances formed when a carbon atom unites with four dissimilar groups of atoms, has long been generally admitted. As to the exact three-dimensional formulæ by which we should represent these two substances, both of which correspond to the ordinary formula $CR^1R^2R^3R^4$, differences of opinion exist; but it is certain that the formulæ must resemble those given in the figures (1 and 2), in so far as these represent three-dimensional arrangements, each unsymmetrical, but such that the two together form a symmetrical whole; in other words, each being the mirrored image of the other. And space-formulæ, in these respects similar, must be admitted for the two compounds formed by the union of a nitrogen atom with five different groups.

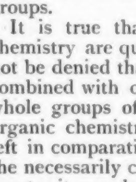


FIG. 1.

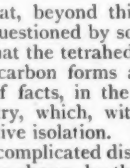


FIG. 2.

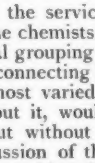


FIG. 3.

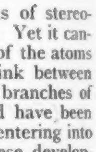


FIG. 4.

It is true that, beyond this, the services of stereochemistry are questioned by some chemists. Yet it cannot be denied that the tetrahedral grouping of the atoms combined with carbon forms a connecting link between whole groups of facts, in the most varied branches of organic chemistry, which, without it, would have been left in comparative isolation. But without entering into the necessarily complicated discussion of these developments, it may be shown, by the consideration of a single instance, that the simple original conception of the three-dimensional asymmetric grouping of dissimilar atoms about the carbon-atom to which they are attached, enables stereochemistry not merely to follow in the steps of structural chemistry, and to explain many anomalies which the latter leaves unaccounted for, but to push its investigations in advance, and to declare the space-relations prevailing in the molecules of substances as yet never analysed, and even never isolated.

The action on polarised light of a substance in solution is a test for the asymmetric grouping of the atoms in its molecules. Just as when we find a substance crystallising in two forms, such as Figs. 3 and 4, having the relation of the right and left hands, we know that these crystals will have the power of rotating the plane of polarised light to the right and to the left respectively; so when we find that a dissolved substance exerts a one-sided action on the light, we know that it possesses a one-sided molecule capable of existing in the right- and left-handed forms (Figs. 1 and 2); which, it will be observed, bear the same relation to each other as the crystal forms 3 and 4.

Further, it is known that although the two members of a pair of substances like those shown in Fig. 1 and Fig. 2, through the identity of their atoms and the equality of the distances dividing them, show no difference in their behaviour towards any ordinary substance, yet they differ entirely in their behaviour towards molecules which are themselves asymmetric. To go back to Pasteur's simile, they resemble equal screws with their threads turned in opposite directions. Both will fit the same hole equally well if it is an ordinary hole; but if it is a hollow screw, then everything will depend upon whether the thread of the hollow screw is right- or left-handed.

Conversely, if towards any substance the right- and

[1] *Science Progress*, February 1896.

left-handed molecules, $CR^1R^2R^3R^4$, act differently, we may conclude that this substance contains molecules which are themselves asymmetric. So that when we find, for example, a certain species of microscopic organism fermenting and destroying a "right-handed" sugar, but not attacking a "left-handed" sugar otherwise identical with the first, we may conclude that those molecules of the ferment which are concerned in the attack are themselves, all or some of them, of a decidedly right- or left-handed character. The line joining their atoms would itself be a spiral, the thread of a screw. And in fact we find living organisms to be largely composed of asymmetric molecules, albuminoids, which themselves exert a one-sided action on light.

It is evident, then, that there is a relation between a ferment and the substance it ferments, as between a solid screw and a hollow screw with threads which enable one to turn in the other.

And the recent researches of Fischer and Thierfelder show the relation between every turn of the two threads to be most intimate. In these experiments, twelve different species of yeast were obtained pure and free from other organisms, and fourteen different sugars were tested with each species of yeast. After eight days it was found that some of the sugars were completely fermented, some only partially, some not at all. And it was observed that the same ferment would attack sugars of widely varying composition, a sugar containing only three carbon atoms, *e.g.*, as readily as one with nine carbon atoms in its molecule. But directly it became a question of the geometrical structure of the sugar molecule the ferments showed the nicest particularity. In the case of sugars containing six carbon atoms and of exactly the same chemical composition, some would ferment readily, and others not at all.

For example, there were tested:

Dextro-glucose.	-mannose.	-galactose.	-talose.
O=C—H	O=C—H	O=C—H	O=C—H
HCOH	HOCH	HCOH	HOCH
HOCH	HOCH	HOCH	HOCH
HCOH	HCOH	HOCH	HOCH
HCOH	HCOH	HCOH	HCOH
HCOH	HCOH	HCOH	HCOH
H	H	H	H
I.	II.	III.	IV.

In each of these four molecules the atoms are the same in kind and in number. The only difference is that whereas in I. there is on one side of the molecule—say on the left, as in the formula given—only one OH group, in II. there are two OH groups on the left, in III. also two, but not the same two, and in IV. there are three. Now it is found that, with the same yeast-species, III. ferments with more difficulty than either I. or II., and the slight further change in the space-relations suffices to deprive IV. altogether of the power of fermenting. This is but one example of the way in which the yeast-cells pick and choose their food. Here, as Fischer observes, we have not simply to do with two similar substances of opposite activity—represented by screws having threads opposed throughout—but we find that of a great number of geometrical forms only a few satisfy the requirements of the yeast-cells; and these few forms are represented by screws in which the threads differ only as regards the direction of one or two of their turns. This may be illustrated by the figures below; for although it is impossible to give an exact representation of the geometrical forms of the molecules of the sugars in question, it is certain that the relations between their forms must correspond to the relations between the figures given, which are formed by a line starting from the COH group (*a*), joining C, OH, and H, always in the order named, and ending at the group CH_2OH (*B*). If the zigzag thus obtained be considered as the thread of a screw, it will be seen that in I. (Fig. 5) the thread is reversed at C^2 and again at C^3. In II. (Fig. 6), which also ferments readily, there is reversal at C^3 only, in

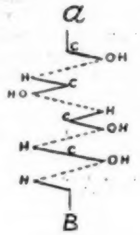


FIG. 5.

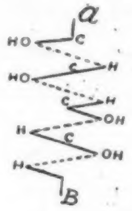


FIG. 6.

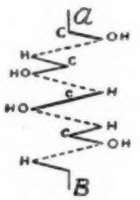


FIG. 7.

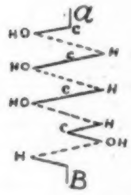


FIG. 8.

III. (Fig. 7), which ferments with difficulty, at C^2 and C^4, and in IV. (Fig. 8), which ferments not at all, a C^4 only.

These relations are shown yet more clearly in the following figures, in which the side of the OH group is represented by a broad curve, while the sharp angle is retained for the H side.

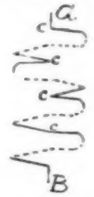


FIG. 9

FIG. 10.

FIG. 11

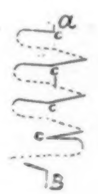


FIG. 12.

In the fermentation of all the sugars, the chief agent is, according to Fischer, proteid matter, a substance which is itself asymmetric, and which, being formed from the carbohydrates of plants, probably possesses a geometrical structure similar to that of the natural six-carbon sugars. Hence it can attack and ferment substances geometrically not far removed from these, *i.e.* from grape

sugar. The question arises, Why do not all yeasts ferment the same sugars? If the origin of the fermenting molecules is in all cases the same, has a change of environment power to alter them, provided many generations of yeast-cells are exposed to the same conditions? In order to answer this question, Fischer and Thierfelder attempted to breed a yeast which should ferment a sugar its ancestors were incapable of attacking. Starting with a yeast which could attack only dextro-glucose, they mixed this sugar with its own weight of a left-handed sugar (l-mannose), and gradually increased the proportion of the latter during three months—a time sufficient for many generations of yeast-cells to succeed one another. When the proportion of glucose was reduced to one-half per cent. the fermentation still went on, but, on reducing it to nothing, fermentation ceased altogether.

So far, then, this attempt has been a failure. In another direction, however, the research was developed with more success. The experiments described had been complicated by the presence of an unknown factor—the life of the fermenting organisms. Analogous experiments were therefore made with lifeless ferments, or enzymes, such as invertin, and emulsion, by allowing them to attack molecules differing only in the space-relations of their atoms. It was found that their power of discrimination was no less exact than that of the living cell. The difference between a glucose- and a galactose-grouping (I. and III. p. 323), which is merely a matter of H and OH changing places, is for them a difference absolutely vital. In the one case they attack the molecule, in the other they will have nothing to do with it. The explanation is similar to that given in the case of the sugars. Invertin and emulsin much resemble proteids, and no doubt possess asymmetric molecules. Their limited action on the glucosides is therefore to be accounted for by the supposition that the approximation of the molecules necessary for chemical action is possible only for molecules of similar geometrical build. To use Fischer's simile, ferment and fermented substance must fit like lock and key. For stereochemistry this image is the more valuable now that the observations have been removed from the biological to the purely chemical field of the lifeless ferments. And indeed for physiological chemistry, also, this last step is no less important, since very many of the processes which go on in the organism are effected by lifeless ferments, and must be largely influenced by the geometry of the molecule.

Nevertheless, those who already deplore the use of materialistic aids to the scientific imagination will find, in this image of the lock and key, but another count in their indictment of stereochemistry.

ARNOLD EILOART.

NOTES.

A REUTER telegram reports that the English tourist steamer *Garonne* arrived at Vadsö on August 2, and landed some of the members of the British expedition to observe the forthcoming eclipse of the sun. They proceeded at once to the south of the Varanger Fjord, where Her Majesty's cruiser *Volage* had already landed the astronomical instruments required for the observations. The steamship *Norse King* also arrived at Vadsö on Sunday with a large party of astronomers to observe the eclipse.

THE prospects of astronomers who have gone to Norway to observe the forthcoming total eclipse of the sun, are decidedly good. A telegram has just reached us stating that Mr. Norman Lockyer, assisted by officers and men of H.M.S. *Volage*, has established a camp on Kio Island, and completed the arrangements for observing the eclipse. As many as forty observers will be employed at this station in recording various characteristics of eclipse phenomena. There is every probability that fine weather will prevail on the day of the eclipse at the station selected.

CANADA is not only to be the meeting-ground of the British Association next year, but also of the British Medical Association. At the annual meeting of the latter Association, held in Carlisle last week, it was decided to accept the invitation to meet at Montreal next year, at the end of August or beginning of September. The British Association meets at Toronto on August 18, so that it will be possible for the medical members of it to attend both meetings if they wish to do so.

DR. A. BALDACCI has undertaken, during the present year, a botanical investigation of Northern Epirus, especially the district of Konitza.

THE annual meeting of the Italian Botanical Society will be held this year at Pisa, from September 10 to 17. The proceedings will commence with an evening reception, and several botanical excursions are arranged during the week.

WE regret to announce the death of Sir William Grove, at the age of eighty-five. His investigations in physical science, and especially the voltaic battery which bears his name, earned for him a wide reputation. He was elected a Fellow of the Royal Society so far back as 1840.

A METEOR of great size is reported to have fallen on July 24, at the mines of Santos Reyes in the State of Chihuahua, Mexico. A loud explosion was heard, and a mass of luminous matter was seen to fall, striking the side of a mountain, and bringing down with it in its course a large amount of rock. The meteor finally buried itself in the ground to a great depth.

AN important astronomical expedition left Chicago a few days ago for Flagstaff, Arizona, and ultimately for Mexico. Mr. Percival Lowell heads the expedition, and will make observations of Mars, assisted by Mr. A. E. Douglas. Dr. T. J. See, assisted by W. A. Coggeshall and D. A. Drew, will study double stars, and make a survey of the southern heavens. Mr. Alvan G. Clark accompanies the expedition, to put up the 24-inch telescope which has been taken.

REUTER'S correspondent at Tromsö reports that the Conway expedition has successfully accomplished the first crossing of Spitzbergen from west to east and back. Starting from their headquarters at Advent Bay, on the south side of Ice Fjord, the party ascended the Sassendal, at the head of Sassen Bay, and, branching off into a long lateral valley, climbed to the high land, which was found to be one vast glacier reaching nearly to Agardh Bay, on the Stor Fjord, or Wybe Jans Water, on the east side of the island.

THE retirement of Prof. Victor Horsley from the chair of Pathology in University College, London, has been made the occasion of presenting him with a testimonial in the form of a piece of plate and an album, as a mark of appreciation of the way in which he has advanced experimental pathology in this country. The album contains photographs of about fifty of the subscribers to the testimonial, together with a record of the work done by them, either in conjunction with Prof. Horsley or in the Brown Institution, and in the Pathological Department of University College, during the time he directed these laboratories.

AS already announced in these columns, the Committee organised by the Kazan Physico-Mathematical Society to obtain funds to found a memorial of the renowned Russian geometrician, N. J. Lobatchefsky, received the total sum of 9072 roubles (£1433) in support of that object. A circular received from Prof. Vassilief informs us that the fund has been utilised in the following manner. A capital sum of six thousand roubles has

been used to found a prize of 500 roubles to be awarded every three years for a geometrical work, and especially one on non-Euclidian geometry, printed in Russian, French, German, English, Italian, or Latin. The first prize will be awarded on November 3, 1897 (the centenary of Lobatchefsky's birth took place on November 3, 1893), and mathematicians competing for it must send in their works not later than November 3 (October 22). The sum remaining after the foundation of this prize has been devoted to the erection of a bust of Lobatchefsky, in front of Kazan University. The bust will be inaugurated on September 13 of this year, and it is hoped that as many foreign men of science as are able will be present to witness the ceremony.

A NOVEL anthropological discovery was made recently three miles from Waynesburg, in the south-western corner of Pennsylvania. A labourer, while ploughing, struck a number of stones, which proved to be graves of a character different from any heretofore discovered. Twenty vaults were found, each twenty-seven inches long, seventeen inches wide, and twelve inches deep, and each covered with a stone forty-two inches long, three inches thick, and twenty-eight inches wide at the head, thirty inches in the widest and twenty-four inches in the narrowest part. The stones were six inches below the surface of the ground. Each vault contained a skeleton of diminutive size, doubled up so as to occupy only eighteen inches of space, with the heads all in an unnatural position, and all facing the south. Under each skull was a turtle, placed as if for a pillow; and in many of the graves were skeletons of birds. The graves were arranged in the segment of a circle of almost four hundred feet in diameter. Many bone beads were found in the graves, but only one piece of metal, a small crescent-shaped copper ornament.

MR. R. H. SCOTT has sent us a copy of the report of Sir Walter Sendall, High Commissioner for Cyprus, on the succession of earthquake shocks, which we have already noted (p. 229) as occurring there at the end of June and the beginning of July. It appears that the first and most violent shock occurred about 11 p.m. on June 29, and up to the date of the report (July 4) the disturbances had continued without sign of abatement. Though most severe at Limasol, the shocks were felt from one end of the island to the other, and upwards from the sea-coast to the summit of Troodos. Mr. Mitchell, Commissioner at Limasol, reports that a shock of alarming intensity occurred at about 8.25 a.m. on July 3; the times of other movements of varying intensity felt on the same day are 12 (noon), 12.38 p.m., 2.52 p.m., 3.22 p.m. From the character of the individual shocks which, though at times very disquieting, did not produce the impression of intense and concentrated activity, it was concluded that the centre of the disturbance was at some distance from Cyprus.

THE last part (No. 12) of the first volume of the *Bollettino* of the Italian Seismological Society has reached us. The complete volume, of which we have from time to time noted the contents, includes twenty-seven papers, eight of these dealing with new instruments, four with studies of recent Italian earthquakes, and eight with the state of volcanic action in the south of the country. More than half the volume consists of notices of earthquakes registered in Italy in 1895. This section is communicated by the Central Meteorological and Geodynamic Office, and its value will be evident from the fact that it contains more than two thousand records of about 550 earthquakes. The majority of these are merely local shocks, perhaps too slight to be detected except with instrumental aid. In eighteen cases the epicentre lay outside Italy, and in three others the pulsations recorded were probably due to distant, but unknown, shocks.

THE Pigmy peoples are a source of perennial interest to anthropologists, as they undoubtedly represent a very ancient variety of the human race. The latest contribution to their osteology is a paper by Dr. R. Verneau, "On the Plurality of Ethnic Types among the Negrillos," in *L'Anthropologie* (vii. p. 153). The new material consists only of a cranium and a pelvis of a Babinga (Akka) woman from the left bank of the Middle Sangha River, about 3° S. The estimated capacity of the cranium is 1440 c.c.; this is very great for a Negrillo, being above the average of European females. Sir W. William Flower's female Akka had a capacity of only 1072, and his female Andamanese averaged 1128; 1200 c.c. is the upper limit of nannocephaly as adopted by Virchow and Kollmann. The skull is very dolichocephalic (73·2), very platyrhine (65·3), mesoseme (87·8), and has a considerable sub-nasal prognathism. These indices agree much more closely with Flower's male Akka (74·4, 63·4, 82·9) than with his female (77·9, 55·3, 82·9). The pelvis is very remarkable; so far as the form and dimensions of the brim are concerned, it is very European, but the height closely approaches that of the negress. Unfortunately there are no data from which the stature could be estimated, but the dimensions of the cranium and pelvis do not indicate pigmy dimensions; and with all due deference to Dr. Verneau, we prefer to await further evidence before accepting this as a typical dolichocephalic Negrillo.

WE have received volume iii., No. 6, and volume iv., No. 1, of that useful publication, *Indian Museum Notes*, which bids fair to rival the valuable American publications on economic entomology, upon which it is modelled. It is freely illustrated with both plates and woodcuts of destructive beetles, butterflies, moths, locusts, &c; but perhaps the most important paper in the parts before us is Mr. E. E. Green's preliminary "Catalogue of *Coccidæ* collected in Ceylon," of which he has made a special study. He enumerates 72 species, 44 of which are described as new, while nearly all the remainder either represent new varieties, or species not previously recorded from Ceylon. When Mr. Kirby published his "Catalogue of the described *Hemiptera Heteroptera* and *Homoptera* of Ceylon," in the *Journal* of the Linnean Society, vol. xxiv., in 1891, he was only able to enumerate seven species of *Coccidæ* as known to occur in Ceylon. Any entomologist who cares to take up the study of a little-known group of foreign insects (or even some of the less-studied families of the smaller British insects, for that matter), may reasonably expect to be able to increase our entomological knowledge by leaps and bounds.

G. BREDDIN has published an interesting article on mimicry in *Rhynchota* in the *Zeitschrift für Naturwissenschaften*, vol. lxix., parts 1 and 2 (pp. 17–46, pl. 1). Most of the cases of insect mimicry previously recorded have been observed among *Lepidoptera*, *Coleoptera*, and *Orthoptera*; for though those presented by *Rhynchota* are equally interesting, that order is at present much neglected by entomologists. Several instances, however, were recorded by Reuter in a paper published, in 1879, in *Ofversigt af Finska Vet. Soc. Förh*, vol. xxi. This paper being in Swedish, has attracted little notice, though the late Dr. Haase made some use of it in his well-known work on mimicry. Breddin, therefore, gives a compendium of the observations of Reuter and others on mimicry in *Rhynchota*, including the results of his own investigations. He defines two forms of mimicry—protective and aggressive—the first to avoid attack, and the second to mask it, of each of which he gives numerous examples, drawn mainly, though not exclusively, from the order *Rhynchota*. The aggressive mimicry of the carnivorous masked bugs (*Reduviidæ*) and their allies is specially noticeable, and attracted the attention of many of the earliest entomologists. Those interested in mimicry will find Breddin's article

important; but it involves so much detail that a full abstract, short of a complete translation, is impracticable. It concludes with a short list of characteristic flower-frequenting beetles, by H. Hahn and P. Breddin-Magdeburg. On the coloured plate which illustrates this paper, the figures representing species of the curious Homopterous genus *Umbonia*, which resemble large thorns, are specially remarkable.

MR. W. E. NICHOLSON'S translation of the treatise in which Dr. Weismann described and discussed "New Experiments on the Seasonal Dimorphism of Lepidoptera," is concluded in the August number of the *Entomologist*. It may be remembered that the same journal published during last year a translation, by Dr. Dixey, of Dr. Standfuss's paper on the effects of artificial conditions on the development of butterflies (see NATURE, vol. liii. p. 540), and this translation, together with the one of which the publication is just completed, will doubtless be highly valued by British entomologists unacquainted with the German language. The concluding paragraph of Weismann's paper, in its English form, reads as follows: "We may now at any rate go so far as to say that the temperature *before* pupation has no influence on the colour and marking of the perfect insect. My experiments with *phlœas* already pointed to this, in so far as in this case the larvæ which hatched from Neapolitan eggs produced very different butterflies, although the pupæ only had been subjected to different temperatures, but the larvæ were all treated exactly alike. Merrifield has shown for *Ennomos autumnaria*, that the very different temperatures in which the larvæ may be reared are without influence on the colouring of the perfect insect. Therefore although, as we have recently learnt, the form of the wings of the imago is outlined very early in the larva, yet the decision as to which of two wing-determinants of an adaptively seasonally dimorphic species shall become active is, at the earliest, given at the beginning of the pupal period."

THE resources of bacteriology are seemingly inexhaustible, and its beneficent applications as varied as they are comprehensive, whilst investigations of theoretical interest are daily assuming a practical importance hardly dreamt of by their original discoverers. Little did Hellriegel, Wilfarth, and Beyerinck imagine that when they announced that certain leguminous crops are able by means of root-nodules to fix the free nitrogen of the atmosphere, and that this was accomplished by the aid of particular bacteria contained in such nodules—little did they anticipate that a few years later the great German firm of colour-manufacturers, Messrs. Meister, Lucius, and Brüning, at Höchst-am-Main, would undertake to deliver, as an article of commerce, cultivations of such bacteria under the name of *Nitragin*, wherewith to inoculate, and so supply the wants of, various leguminous crops. This is, however, what Dr. Nobbe, the distinguished follower in the footsteps of Hellriegel, has rendered by his brilliant researches an accomplished fact. Pure cultivations of nodule-organisms suitable to the growth of no less than seventeen different varieties of leguminous field crops may now be purchased from this enterprising firm. Each bottle bears a different coloured label according to the crop for which it is destined, whilst the German as well as the botanical name of the plant is also affixed. About half an acre of land may be inoculated for half-a-crown, which represents the price of a single culture bottle. The cultivations are prepared at the Höchst Works, under the direction of a former assistant to Dr. Nobbe, and the result of this latest development of practical bacteriology will be awaited with the greatest interest. Meanwhile the English Government, whilst contemplating extensive financial assistance to the agricultural interests in the country, might do well to consider whether more lasting benefit to the community might not be derived from the better endowment of science in our local colleges, and the encouragement of original research. It is the lack of this support, which in Germany is fostered so jealously, that handicaps the work, and places the worker at such a great disadvantage when compared with our more fortunate continental neighbours.

WE have received from the Deutsche Seewarte, Hamburg, a circular setting forth proposals on various questions to be raised by it at the Meteorological Conference in Paris, in September next (1) on the improvement and simplification of the exchange of weather telegrams over Europe. The introduction of the circuit-system of telegraphy, which already exists in the United States, would greatly accelerate the arrival of weather reports. Also the omission of certain details, such as the readings of wet-bulb thermometers, and maximum and minimum temperatures, not being of great importance in the preparation of weather forecasts, would lessen the cost of telegrams. (2) Uniformity of hours of observation. At present, differences of time of from one to two hours exist between the observations of different countries. So far as this country is concerned, the proposal is to take observations at 7h. a.m. instead of 8h. a.m. To carry out this recommendation, it would be necessary to open many provincial telegraph stations specially for the weather reports, as generally they do not open till 8h. a.m. Greenwich time; and in Ireland, where Dublin time is used, the offices would have to be opened still earlier. (3) Extension of the international system of meteorological publications, by means of monthly reports, and five yearly *résumés*: the investigation of the anomalies of pressure and temperature to appear only in the year-books. (4) Instruction in meteorology in schools and universities. (5) Comparison of the various sunshine recorders, and uniform instructions for the observation and exposure of the instruments. The instruments mostly in use are Jordan's photographic recorder, and the Campbell-Stokes frame and glass sphere in which the sun scorches a trace on prepared paper. (6) Maritime Meteorology. The Deutsche Seewarte will present two special papers to the Conference on the discussion and utilisation of observations made at sea.

THE Report of the Botanical Department of the State Agricultural College for Michigan is chiefly occupied by a list of the hardy plants, 1335 in number, grown in the Botanic Garden. It also contains a report of the present condition of the Herbarium (42,861 species of Flowering Plants), and some notes on Forestry.

A LARGE portion of *Botany Bulletin*, No. 13, of the Department of Agriculture, Brisbane, is occupied by a descriptive paper on the Chemistry and Economic Products of a number of Queensland Gums and Resins, by Dr. J. Lauterer. It also contains descriptions of a number of new Queensland flowering plants; additions to the Mosses, Hepaticæ, Lichens, and Fungi of the colony; and two additions to the Flora of New Guinea.

THE Helmholtz Memorial Lecture, delivered by Prof. G. F. Fitzgerald before the Chemical Society in January last, is printed in the July number of the Society's *Journal*, with a heliogravure portrait of the great investigator in honour of whom the lecture was given. It would be difficult to compose a better appreciation of a man's contributions to science than that contained in Prof. Fitzgerald's discourse.

IN another part of this issue (p. 329) will be found a notice of the fifth of an attractively produced series of reprints of old meteorological papers, edited by Dr. Hellmann. The sixth of these, "Neudrucke von Schriften und Karten über Meteorologie und Erdmagnetismus," is a facsimile reprint of Hadley's paper "Concerning the Cause of the General Trade-Winds," published in the Royal Society's *Transactions* in 1735. The paper occupies little more than four pages of the publication, but Dr.

Hellmann makes up for its slenderness by means of a short biography of Hadley, and several helpful and interesting notes. The reprints are published by Messrs. A. Asher and Co.

THE *Journal of Botany* reprints some very interesting extracts from Mr. T. Kirk's presidential address to the Wellington (New Zealand) Philosophical Society, on the displacement of native by introduced species of plants. Next to man, the chief agents in this destructive work in New Zealand are sheep and rabbits, but the black rat has also had his share. "Some districts are eaten almost bare by these close feeders, little being left except the tough bases of *Poa cæspitosa* and the wiry ligneous stems of *Mühlenbeckia*, and similar plants; even the woolly leaves of some species of *Celmisia* are often closely cropped, the result being that the more delicate plants are all but extirpated over large areas." Introduced plants like *Silene anglica*, *Erigeron canadensis*, *Rumex obtusifolius* and *crispus*, *Bromus sterilis*, and *Holcus lanatus*, have almost driven out the original littoral vegetation in some districts. Even more destructive are the ravages caused by the parasites, animal and vegetable, which some of these strangers bring with them. Some idea of the extent of this invasion may be gathered from the fact that the first catalogue of naturalised plants in New Zealand, published in 1855, comprised forty-four species; while at the present time Mr. Kirk is himself acquainted with 304 species, while others put the number at 382.

WE have received the first number of vol. iii. of *Poggendorff's Biographisch-Literarisches Handwörterbuch der Exacten Wissenschaften* (J. A. Barth, Leipzig), which is to contain short biographical notices of mathematicians, astronomers, physicists, chemists, mineralogists, geologists, geographers, &c., living within the period 1858–1883. The first number extends from "d'Abancourt" to "Beilstein," and the whole volume will contain about fifteen numbers, appearing at intervals of six weeks (3*s*. each). The times preceding 1858 have already been dealt with in the first and second volumes (price 28*s*.), and any gaps which have been discovered since will be filled up in the present volume. A fourth volume is to cover the years from 1883 to 1900. The whole work will be a monument of careful compilation, and will do much to unify the world of science. The plan of the work is admirably designed. Short biographical notices are followed by a detailed enumeration of the papers and books contributed to scientific literature. Among the men of this first number, Sir G. B. Airy is *facile princeps* in the volume of his writings, as the four closely-printed columns of titles testify. There are many Arabian and other philosophers who are now seldom heard of, such as Abraham ibn Esra of Toledo, Al Marokeschi of Marocco, and Al Mahani of Khorasan, which this dictionary preserves from unmerited oblivion. Taken as a whole, the dictionary appears to be highly trustworthy, and the print and paper leave nothing to be desired.

IN the current number of the *Comptes rendus* there is an account, by M. H. Moissan, of some further experiments on the preparation of the diamond. With the view of obtaining the greatest possible pressure upon the solution of carbon in iron during solidification, the cooling with mercury or other metal was arranged in such a manner that small spheres from 5 mm. to 10 mm. in diameter were produced. These spheres gave specimens both of the black and transparent varieties of diamond, which, although very small (0·01 to 0·02 mm.), were remarkably regular and perfect in shape, agreeing exactly with the forms found in nature.

THE additions to the Zoological Society's Gardens during the past week include a Rhesus Monkey (*Macacus rhesus*, ♀) from India, presented by Mr. V. Lloyd; two Amaduvade Finches (*Estrelda amandava*) from India, a Paradise Whydah Bird (*Vidua paradisea*) from West Africa, presented by Miss M. von Laer; a Raven (*Corvus corax*), British, presented by Mr A. H. Cullingford; a Martinique Gallinule (*Ionornis martinicus*) from South America, presented by Mr. A. W. Arrowsmith; a Cape Viper (*Caucus rhombeatus*), a Puff Adder (*Vipera arictans*), a Cape Bucephalus (*Bucephalus capensis*), five Hoary Snakes (*Coronella cana*), a Ring-hals Snake (*Sepedon hæmachates*), four Crossed Snakes (*Psammophis crucifer*), six Rufescent Snakes *Leptodira rufescens*), three Rough-keeled Snakes (*Dasypeltis scabra*), four Rhomb-marked Snakes (*Psammophylax rhombeatus*), a Delaland's Lizard (*Nucras delalandii*), a Defenceless Lizard (*Agama inermis*) from South Africa, presented by Mr. J. E. Matcham; four Midwife Toads (*Alytes obstetricans*), South European, presented by Prof. Gustave Gilson; a Gentoo Penguin (*Pygosceles tæniatus*) from the Falkland Islands, deposited; eight Amherst Pheasants (*Thaumalea amherstiæ*), two Peacock Pheasants (*Polyplectron chinquis*), two Himalayan Monauls (*Lophophorus impeyanus*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN.

THE PLANET SATURN.—In the *Astronomische Nachrichten*, No. 3365, Prof. Barnard comments upon the accounts of various new markings on the rings and body of this planet. In company with Profs. Burnham and Hough, he carefully examined Saturn with the 18½-inch refractor at Dearborn Observatory. The planet was in a good position for seeing, being on the meridian, and during the evening several difficult double-stars were accurately measured. In spite of this, no abnormal features could be discerned, either on the globe or on the rings. The recently reported observations of new divisions, ragged edges to the crape-ring, &c., were all invisible. In fact the planet appeared very similar to what Prof. Barnard usually saw with the 36-inch Lick, although the latter, with its larger aperture, made the identification of details less difficult.

NEW NEBULOSITY IN THE PLEIADES.—W. Stratonoff, in the *Astronomische Nachrichten*, No. 3366, describes the results of recent long-exposure photographs of the Pleiades, taken with a refractor of 13 inches aperture. Three photographs are mentioned, obtained with exposures of 9h. 54m., 17h. 36m., and 25h. The first two show most of the known nebulosity, but the third shows the existence of several new features. The chief of these is a long straight streak of nebulosity extending from $\alpha = 3$h. 40·7m., $\delta = +24° \, 4'$ to $\alpha = 3$h. 41·9m., $\delta = +24° \, 4'$, roughly about 20′ north of Alcyone. The breadth of this is from 20″ to 30″; it is almost parallel to the neighbouring line of nebulosity described by M. M. Henry, and has a very similar form.

Another slight nebulosity is visible on the plate near the star 18m., in the form of several filaments lying north and south, and varying in breadth from one to three minutes of arc.

NEW VARIABLE IN HERCULES.—Mr. T. D. Anderson, of Edinburgh, gives in the *Astronomische Nachrichten*, No. 3366, a description of his observations of a 9th magnitude star, leading to the discovery of its variability. This is the star B.D. + 27°·2772, whose position for 1855·0 is given as R.A. = 17h. 4m. 58·4s., Decl. + 27° 14′·3. The star could not be found in September 1895, using a 2½-inch refractor, but in October of the same year it was easily seen with the same instrument. Taking two neighbouring stars of magnitude 8·8 and 9·6 for comparison, he found the variation in magnitude to be from 9·2 to below 10 in about a month. In July 1896 he again found the star to be invisible as in September 1895, although the neighbouring 9·6 magnitude star was easily seen again.

THE INSTITUTION OF MECHANICAL ENGINEERS.

THE annual summer meeting of the Institution of Mechanical Engineers was held last week in Belfast, commencing on Tuesday, July 28, and concluding on Friday, July 31. There were two sittings for the reading and discussion of papers, the following being a list of those presented:—

"Flax Scutching and Flax Hackling Machinery," by John Horner, of Belfast.

"Electric Lighting in Belfast," by Victor A. H. McCowen, Electrical Engineer to the Belfast Corporation.

"Unusual Corrosion of Marine Machinery," by Hector MacColl, of Belfast.

"Rope Driving," by Abram Combe, of Belfast.

"Description of the Belfast Gas Works," by James Stelfox, Engineer and Manager.

"Description of the Alumina Factory at Larne Harbour," by James Sutherland, Manager.

"Partially immersed Screw-Propellers for Canal Boats; and the influence of Section of Waterway," by Henry Barcroft, of Newry.

The last paper was not read.

On members assembling on Tuesday, July 28, in the Examination Hall of Queen's College, Belfast, addresses of welcome were given by the Lord Mayor of Belfast, Mr. Pirrie, and by Mr. W. H. Wilson, the chairman of the Reception Committee. After this the chair was taken by the President, Mr. E. Windsor Richards, and the first paper was read.

This was Mr. Horner's contribution on flax scutching and flax hackling machinery. It was illustrated by a number of wall diagrams, without the aid of which it would be impossible to describe the intricate mechanism used in the flax industry. It is a task we will not attempt. A point of economic interest which came out in the discussion may, however, be referred to. A gentleman connected with the industry pointed out the lamentable waste that occurs owing to the unsatisfactory methods of scutching followed in Ireland. It appears that the flax-growers are always more anxious to get their money quickly for their produce than to get a full return. To scutch flax properly requires time, and also more costly machinery than is generally used in Ireland. On the continent the growers are more far-sighted, and have a larger command of capital; at any rate they have superior machines, which are more expensive at first cost, and, moreover, take a longer time in performing the operations. The foreign growers have their reward. The yield is 20 to 25 per cent. greater than with the Irish machines; and though it costs about double as much to scutch a given quantity of flax on the continental system, the yield is so much greater that a far larger profit is ultimately obtained. We gathered also from subsequent visits to the flax mills in Belfast that the continental flax is much preferred by the manufacturers, being cleaner and more easily worked. One would be inclined at first sight to attribute these facts to the conservative and shortsighted methods of the people of this country; for we are very prone to accuse ourselves of errors of this kind. It may be some satisfaction, therefore, to persons of a cynical disposition to find that the generally astute Americans are guilty of a similar fault. Mr. Dobson, of Bolton, a well-known maker of cotton-spinning machinery, told the meeting that there was an immense loss in the preparation of raw cotton, due to the very primitive ginning machinery used by the cotton-growers. It is evident that both here and in America we have something to learn from the more frugal and painstaking flax-farmers of the continent of Europe.

Mr. McCowen's paper on the electric lighting in Belfast followed. The chief feature of interest in the Belfast installation is the fact that all the prime movers are gas engines. Six of these are on the Hartley and Kerr system. They are supplied by Dick Kerr and Co., of Kilmarnock. Four are double acting, with the cylinders working tandem-wise, and having two pistons on the same rod. These engines run at a speed of 160 revolutions per minute, and indicate 120 h.p. The number of explosions per minute is 320 or 330, or 2 per revolution. The remaining two of the six gas engines are single cylinder and double acting. They also run at 160 revolutions, and indicate 60 h.p. The number of explosions per minute is 160, or one per revolution. Naturally the cyclical variation in speed of the tandem engines is very small, owing to the number of explosions, their low initial pressure, and their even distribution; the number of explosions being four to one, in comparison with the single cylinder, single acting engine; there being four complete Otto cycles in two revolutions. The method of governing is worthy of attention, as being different from that usually adopted of missing an explosion. The impulses are continuous, and the supply of gas is graduated per stroke according to the load. The quantity of air supplied to the cylinder is practically constant, the quantity of gas only being varied. This under ordinary cases would lead to a difficulty of ignition. As is well known, a poor mixture of gas and air ignites slowly; but it is said that stratification takes place in the cylinder. Taking advantage of this, gas is admitted to the cylinder later and later in the charging stroke; although even at full power a considerable quantity of air is drawn into the cylinder before gas is taken in. The full supply of air almost immediately follows the piston, while there is only a small portion of rich and explosive mixture near the ignition chest. It will be easily understood that the mechanism by which the somewhat novel operations are carried out is of an interesting nature. It was explained by the author by means of wall diagrams; but in the absence of these we can only refer our readers to the published transactions of institutions in which the diagrams will be reproduced.

These slower running engines drive the dynamos by rope-gearing, but there are two smaller engines of the high speed vertical type, manufactured by the Acme Gas Engine Company of Glasgow. They have four single-acting cylinders arranged in two lines of two in tandem, working on to opposite cranks. At full speed they run at 380 revolutions per minute. In the paper tables were given detailing the various conditions of running, quantity of gas used, &c. Without going into the details of these tables, it may be stated that the efficiency of the tandem engines does not appear to be very high, 27·4 cubic feet per electrical h.p. per hour being the best result. This, of course, could be beaten by an engine running on the Otto cycle; but we must remember that for electric lighting purposes the Otto cycle, with its one impulse in four strokes, is not well adapted unless an enormously heavy fly-wheel be used. It is the old problem that so often faces the engineer: to get efficiency in one direction something has to be sacrificed in another; and, so far as electric lighting is concerned, the engineer apparently has to choose between an increased consumption of gas, or the prospect of unsteady lights. From experience we can say that the Belfast station gives good results if we simply regard the product. But we believe that when an extension of the station is undertaken—as there is every prospect there will be shortly—steam, and not gas, will supply the motive power.

On the second day of the meeting, Wednesday, July 29, Mr. Hector MacColl's paper on the unusual corrosion of marine machinery was read. It appears that a cargo steamer was sunk on the coast of Scotland; she was loaded with "burnt ore," and was under water for a week. On examination, when the vessel was once more floated, the machinery was found to present an extraordinary appearance. All wrought-iron work was deeply and roughly corroded, and planed cast-iron work was rendered so soft as to be easily cut with a knife. As the engines of steamships are generally very little injured by submergence, even for lengthened periods of time, it was evident that there was, as the title of the paper indicated, an unusual cause for this state of affairs. This was found in the cargo. Burnt ore is the residue from the manufacture of vitriol from sulphur pyrites, and is generally found to contain about 4 per cent. of sulphate of copper, together with a little sulphate of iron, due to the sulphur not having been completely burnt out of the ore and becoming oxidised with sulphates. The sulphate of copper would be more or less completely dissolved in sea-water; and, as the latter contains a considerable quantity of chloride of sodium, this would react on the sulphate of copper, forming sulphate of sodium and chloride of copper. The sulphate of copper and chloride of copper are both soluble in water, and a solution of either or both dissolves wrought-iron and cast-iron. The chloride is more energetic in its action than the sulphate; but in time a solution of either, no matter how weak, will dissolve an atom of iron for every atom of copper present. If is satisfactory to know that the author was able, notwithstanding the great apparent damage done, to put the engines and boilers into working order again, and the ship is now doing duty on the high seas.

The next paper was perhaps the most important read at the meeting; it was Mr. Abram Combe's contribution on rope driving. As is fairly well known, Belfast is the home of rope driving as a means of conveying power from motor to machine; so far, at any rate, as mill purposes are concerned. The inventor was Mr. James Combe, of the author's firm of Combe, Barbour, and Combe, who are very large manufacturers of flax-spinning machinery. This gentleman in 1856 applied an expanding pulley with V-shaped sides to the differential motion of flax and tow roving frames, conveying the power by means of a round leather rope. He was struck by the efficiency of this gearing, and this led him to try the application of the same

means of transmission to larger power. As a result of a number of experiments he found that the following were the best ratios of diameters for ropes and pulleys :—

$1\frac{1}{4}$ inch diam. rope	3 feet diam. pulley	ratio	1 to 28·8
$1\frac{1}{2}$,, ,,	4 ,, ,,	,,	1 to 32·0
$1\frac{3}{4}$,, ,,	5 ,, ,,	,,	1 to 34·3
2 ,, ,,	6 ,, ,,	,,	1 to 36·0

In regard to power transmitted, it was found that when working under ordinary conditions the foregoing sizes of rope transmit, for each 100 revolutions per minute made by the pulley, the following :—

Rope $1\frac{1}{4}$ inch diam.	on 3 feet pulley	would give	5 I.H.P.
,, $1\frac{1}{2}$,,	4 ,,	,,	8 ,,
,, $1\frac{3}{4}$,,	5 ,,	,,	11 ,,
,, 2 ,,	6 ,,	,,	15 ,,

These figures may be exceeded under more favourable circumstances. The best angle of the groove on the pulley was found to be 45°, and the best speed of rope 3300 feet per minute. Illustrations and descriptions were given of many very ingenious forms of rope driving, by which power was conveyed from a driver to a single driven pulley under conditions that would have been impossible with belts, or in any case unless complicated trains of wheel gearing had been employed. In the discussion which followed the reading of this paper, a good deal of light for the uninitiated was thrown on rope driving practice. The importance of splicing was brought to the fore, and on this depends to a large extent the durability of ropes used for conveying power. A short splice will not do at all, and even the "long splice" ordinarily made by the mariner is insufficient. For 3-inch ropes the splice has to be 12 feet long; the strands being cut and divided, so as to avoid producing what sailors call a "gouty" length; that is, one where there is an increased diameter. Three patterns of rope are used; the three strand, four strand, and the served rope. The former is far the easier to splice, the latter the most difficult. A served rope, however, has the greatest flexibility; a very prominent virtue in a driving rope, as it leads to longevity, and enables smaller pulleys to be used without ill effect. In regard to material, cotton appears to be the favourite. It is almost universally used in England; naturally so in the Lancashire district, where rope-driving practice is so largely followed. In Ireland manilla appears to be most often used. There was one speaker, who came from India, and who said that he had used coir rope with great success; this is made from the fibrous material of the husk of the cocoanut. We should have thought this substance would have been altogether too elastic for the purpose. Another speaker, Mr. McLaren, had used rope-driving for ploughing purposes, but had gone far beyond the proportions advised by the author in his table. For instance, he had used a $\frac{3}{4}$-inch rope to transmit 40 horse-power, whilst his pulleys were no more than 20 inches in diameter. This rope we understood him to say was a manilla one, but the proportions seem altogether extraordinary. We should have thought a wire rope would have been more likely to answer the purpose. The speaker, however, drew the moral that too high a factor of safety was demanded by engineers in rope driving. Later on Prof. Goodman stated that he had calculated the average factor of safety in rope driving at about 90 per cent.

One of the excursions during the meeting was made from Belfast to Larne Harbour, to visit the alumina factory there situated. A description of this factory formed the basis of Mr. Sutherland's paper. Although, as is universally known, aluminium is one of the most abundant metals found in the earth, there are not many of the compounds containing it which render themselves readily to the extraction of the metal. Bauxite is the one generally used for its production, and large deposits of this have been found in County Antrim. The analysis is as follows:—Alumina is 56 per cent., corresponding to aluminium 29·9 per cent., peroxide of iron 3 per cent., silica 12 per cent., titanic acid 3 per cent., water 26 per cent. The peroxide of iron, silica, and titanic acid have to be separated out before the extraction of the metal from the alumina is attempted; and it is the function of the Larne works to carry on these operations; the smelting of the ore being done by electrical methods at Foyers. That, however, is an operation which does not come within the scope of the paper now before us, but may form the subject later on of another contribution in the transactions of the institution.

It is the Bayer process which is used at Larne. The bauxite, as received from the mines, is first ground and sifted, after which it is taken to a calciner in order to remove the organic matter present, which would prevent the subsequent separation of the alumina from the caustic soda. The calciner is an iron tube lined with fire-brick, and caused to revolve on rollers. It is inclined at a necessary angle, the heat from the furnace passing up through the tube. As the tube inclines, the bauxite travels to the lower end, and falls out into a receptacle. The alumina is extracted from the ground bauxite by treating it with a strong solution of caustic soda under pressure. This operation is carried out in Kiers. A soluble compound of alumina and soda (aluminate of soda) is thereby formed, while the peroxide of iron, silica, and titanic acid remain as an insoluble compound. The Kiers are steam-jacketed, and have paddles mechanically actuated to agitate the mixture. The steam pressure in the jacket is carried up to 70 or 80 pounds, and the mixture is subjected to the heat corresponding to the pressure for two or three hours until decomposition is complete. The liquid product of the Kiers is then passed through filter presses, the impurities being insoluble are retained, while the liquid aluminate runs into tanks. The residue, or cakes of impurities, are afterwards washed to extract as much of the aluminate of soda as possible; and the washings are used for diluting the product of the Kiers. Centrifugal pumps are employed for this purpose. At present the red mud forming the residue is useless, and there is an opportunity for any chemist to suggest a means by which it could be utilised. Experiments are being conducted in this direction by the Company. The lyes from the presses contained in the filter tank are afterwards subjected to another filtering process, being passed through cellulose, consisting of paper-makers' pulp. About fifty pounds of cellulose is boiled with water to a thin pulp, and is run upon sieves; it soon settles down, and is then ready to receive the lyes, arresting all finely divided, insoluble particles that have escaped from the filter presses. Finally, there is another filtering process.

It is now necessary to separate the alumina from the soda. This is brought about by the addition of excess of more hydrate of alumina to the hydrate of alumina itself, and in this way about 70 per cent. of the alumina in combination with the soda separates out in thirty-six hours. The hydrate of alumina is then pumped out of the decomposing cylinders, in which the latter process has taken place, sufficient however being allowed to remain behind in the cylinder for beginning the decomposition of the next charge of liquor admitted. The hydrate of alumina pumped out is filtered through filter-presses, and the last traces of soda are removed by washing. The hydrate of alumina is then taken to the calcining furnace, where the water of hydration is driven off at a low temperature, leaving the alumina perfectly anhydrous. It will, however, take up water again readily, and to prevent this it is heated to about 2000° F., when it becomes crystalline, and not so liable to absorb moisture. The weak soda liquors which are obtained are concentrated by a triple-effect evaporator.

On the afternoon of Wednesday he members and their friends were shown these processes in operation at Larne.

The last paper read was that by Mr. Stelfox. It was not discussed, the time for the conclusion of the meeting having arrived.

The Belfast meeting was a complete success, the whole arrangements being carried out most satisfactorily. A large number of the works of Belfast were visited by members, manufacturers being most liberal in opening their establishments to members, and generally showing that hospitality for which Ireland is renowned. The summer meeting of next year is to be held in Birmingham, the city in which the Institution of Mechanical Engineers had its origin fifty years ago next year.

OLD WORLD METEOROLOGY.[1]

IN the year 1508 a book was published in Germany under the title of the "Bauern-Pracktik." This book had a wide circulation. It taught the farmer, the sailor, the merchant—all, indeed, who were interested in the weather—what would be its

[1] "Die Bauern Praktick. Neudrucke von Schriften und Karten über Meteorologie und Erdmagnetismus." Herausgegeben von Prof. Dr. G. Hellmann. (Berlin: A. Asher and Co., 1896.)

character, not only for the coming year, but in all future years. This book, with its many editions and translations, has now become very scarce, and a facsimile copy of the original has been reproduced by Prof. Hellmann, who, with the affection of the ardent bibliographer, has traced it with infinite difficulty through many libraries and into many unexpected places. To this little book, which consists of only eight or nine pages, the editor has added an introduction of some seventy, bearing the same relation to the original work that Falstaff's sack did to his bread. And just as Falstaff found his bread an unwelcome addition, so these last few pages are a hard nut to those who have not made a critical study of the German of the fifteenth century. But Prof. Hellmann's introduction gives great assistance, and by the help of it we have made out some of the rules and predictions, which appear quite as trustworthy as the prognostications that our modern weather prophets circulate, and in which no doubt they find their account.

The proper title of the book appears to be "In disem biechlein wirt gefunden der Bauren Pracktick unnd regel darauff sy das ganz iar ain auffmercken haben unnd halten." Under this title is a woodcut of a figure contemplating a crucifix, the whole surrounded by a scroll-work not badly executed. The text can be conveniently divided into three parts. The first shows how the weather, the harvest, the crops, and so forth, can be predicted from observations of the weather at Christmastide. If the weather is fair and clear on Christmas night, then there will be plenty of wine and fruit. If the weather be contrary, so will the matter fall out contrary. Then the wind is of importance. We understand the author, whoever he may be, to say that if the wind gets up at sunrise the year will be dear; but if the wind gets up at sunset, the king and the great lords will die. Like our modern prophets, the author is not afraid to indicate the course of political events. A fruitful year is foreshadowed by a west wind at midnight, but a southerly wind at midday betokens that there will be daily thunder. The author's word is "Krackhair," but whether we are justified in tracing it to "Krachen" must be decided by the student of old German. One can only regret that, with so simple a rule for his guide, one should be hindered from getting the full benefit, by his ignorance of the language in which it is written.

Then the author goes on to tell us what will happen when Christmas day falls on a Monday, Tuesday, and so on to Saturday; a very simple cycle, a little disturbed by the introduction of leap years, but nevertheless of great value to simple folk. With Christmas day on Sunday, among other things we are told that the summer will be hot and dry and fine, the autumn damp and wintry. There will be plenty of corn and wine and much honey, and if the text be correctly construed it says that "old people will die willingly": but this seems such a contradiction to known facts, that the German must speak for itself to those who can understand it. "Die alten leüt sterben geren."

This is the kind of information that we get for each of the days of the week, and it is curious to notice the important part that honey plays in the predictions. He kills his king and his princes and his young men and his old women, but through all disasters he evidently remembers his honey, and in his partiality ranks it of equivalent importance to corn and wine.

In the next section we are told what will happen by the condition of the weather during twelve days, presumably between Christmas and Epiphany. The rules are very short, and are given without ambiguity or hedging. If the sun shines throughout Christmas day it indicates a peaceful year; if on the next day, however, money vanishes and corn becomes dear. But the third day presages something so awful that one must hope his translation is at fault. "So kriegen die bischof uñ die prelaten gern /uñ wirt irrung und den pfaffen." The spectacle of bishops, priests and deacons quarrelling is so opposed to our knowledge of their character, that some mistake has evidently glided in here, or the words do not convey the meaning which they apparently do to one only acquainted with modern German.

The book concludes with remarks of similar value on each month more or less depending upon Church festivals, and thus connecting Church observance with meteorological phenomena. This strikes one as an ingenious method of ensuring observance of the Church's calendar. If the sun shines on St. Vincent's day, we are told there will be much wine; if on St. Paul's day, a fruitful year. This last prediction recalls another of probably still older date. "Clara dies Pauli bona tempora denotat anni."

When the book passed over into a French translation a lighter note seems to have been struck, judging from the jingling rhymes by which it is recommended to the reader.

Prognostication nouvelle
Des anciens laboureurs m appelle
Je fus de Dieu transmise aux vieulx
Qui m ont approuvee en tous lieux
Et comme je diray motz a motz
Les anciens ne font pas sotz
Achepte moy quand m auras veu
Car tu ne seras point deceu
Je te donray une doctrine
Qui te vauldra d'or une mine
Et hardiment sur moy te fonde
Car je dure autant que le monde
Et si te veulz bien advertir
Que je ne te veulx point mentir.

The contents appear, however, to be but a translation of the older German work, and the subject is regarded as too sacred and important to allow any license to the playfulness of French wit, to enliven the sobriety and heaviness of the German original.

In our own country, under the title of the "Husbandman's Practice," the book seems to have enjoyed a wide popularity. No divine authority was, however, invoked, but the predictions were fathered upon the astronomers, forsooth, and this too about the time that Newton published the "Principia," and Flamsteed was at work at Greenwich. The preface runs: "The wise and cunning masters in astronomy have found, that man may see and mark the weather of the holy Christmas night, how the whole year after shall be on his working and doing, and they shall speak on this wise."

"When on the Christmas night and evening it is very fair and clear weather and is without wind and without rain, then it is token that this year will be plenty of wine and fruit." And without much alteration or addition the rigmarole is translated from the German. From a remark of Prof. Hellmann, it is to be gathered that the legend of St. Swithin as a guide to the July weather did not appear in the early German editions. It first made its appearance in the English version some time before 1668.

We find it somewhat difficult to take the work of Prof. Hellmann seriously, the predictions are so crude and ludicrous; but it is impossible to read his preface without acknowledging the care and thoroughness with which he has done his work, and the labour he has bestowed upon the subject. The book itself may not be worth a second thought, but Prof. Hellmann has made it serve the purpose of developing two lines of investigation of great interest and importance, into which, however, we cannot adequately enter. In the first place, how are we to account for the widespread hold upon the public mind that such a book had, and for so long maintained as a popular treatise? Whence comes the deep-seated love of the marvellous and superstitious, which manifested itself in many ways, and in particular is connected with the twelve days about the time of the winter solstice, when the days are at their shortest. Prof. Hellmann endeavours with some success to trace evidences in the remote past of the tendency to predict the weather from observations made on these twelve days, each day corresponding to a month in the forthcoming year. That these days have become connected with a Christian festival is to a certain extent an accident of later date.

This observation of the weather about the time of Christmas is brought out more clearly in the second inquiry, when the question of the origin of the book itself is raised, or rather on the authority on which these wise saws rest. Discarding such modern authorship as Heiny von Uri or Thomas von Filtzbach can claim, the editor shows that the book, or at least the contents of it, circulated in a traditional or MS. form long before it took its printed shape. With difficulty he has traced and compared ten MSS., dating back from 1478, all possessing common features indicating a common origin, and pointing out with some degree of plausibility to the pages of the Venerable Bede as the oldest known source. But this wish to penetrate the future, and the formation of rules for general guidance are older than this remote date, and traces of ancient customs and old predictions are to be found in all parts of the globe, wherever written records have been preserved. But there is the curious fact to be remarked, that the older MSS. show a tendency to refer the grounds for prognostication to the Calends of January rather than to the Christmas festival, and in the case of a fifteenth century MS. both are mentioned. Christmas is quite a late innovation, and the growth in importance of the great Christian festival can be traced by its gradual displacement of the older Calendar in these meteorological superstitions.

PRIZES OFFERED BY THE SOCIÉTÉ D'ENCOURAGEMENT

THE *Bulletin* of the Société d'Encouragement pour l'Industrie Nationale contains a list of the medals and prizes to be awarded in 1897 and 1898. Amongst these, the following prizes are proposed for 1897. In the Mechanical Arts: for improved methods in milling of grain (2000 francs); for a motor weighing less than 50 kilogrammes per horse-power developed for use in aërial navigation (2000 francs); for a study of the coefficients necessary for the calculations of an aërial machine (2000 francs); for a small motor suitable for domestic use (2000 francs); for improvements in machine tools (2000 francs).

In the Chemical Arts: for the utilisation of waste products (1000 francs); for a new method of preparing fuming sulphuric acid or sulphur trioxide, which shall be more economical than those at present in use (2000 francs); for a liquid which shall replace sulphuric acid in dyeing, especially of silk, without exercising the same destructive action on the fibre (1000 francs); for a scientific study of the physical and mechanical properties of glass (2000 francs); for the preparation on the large scale of a new alloy of iron possessing specially useful properties (2000 francs).

In the Economic Arts: prizes are offered for the construction of a hydro-extractor that can be worked continuously (2000 francs), and for important improvements in the manufacture of permanent magnets, with especial reference to their stability (3000 francs).

In Agriculture: for a study of alcoholic ferments (3000 francs); for the best study of the diseases of cider and the means of arresting their development (2000 francs); for the best practical means of destroying one of the insect enemies of the vine (1000 francs). There will also be awarded in 1897 a prize of 2000 francs for an economic study of an industrial centre in France, and of 1500 francs for a study of insurance against involuntary want of employment.

The more important prizes offered for 1898 include the Marquis d'Argenteuil prize of 12,000 francs for the discovery of the greatest service in developing French industry; for a publication of service to chemical or metallurgical industry (2000 francs); for an experimental study of the physical or mechanical properties of some metal or alloy in common use (2000 francs); for the invention of new methods of utilising petroleum (0 8 k. or higher) advantageously and without danger, for either manufacturing or domestic purposes (2000 francs); for the best varieties of barley for brewing (1500 francs); for the reconstitution of vineyards upon chalky soils (3000 francs); and for the best study in vine culture in France (2000 francs).

SCIENCE IN THE MAGAZINES.

GLACIALISTS making arrangements for their summer migration to Switzerland, and other geologists interested in ice-work, should read what Dr. A. R. Wallace has to say in the *Fortnightly* on "The Gorge of the Aar and its Teachings," before they set out, and they will then be able to judge for themselves the weight of the conclusions drawn. Dr. Wallace thinks the phenomena presented by the valley of the Aar afford "a fresh and very powerful argument in support of the power of the ancient glaciers both to deepen valleys and to grind out lake-basins," and his article is written to prove the correctness of this view. In the enclosed valley with its two small rock-basins in which the Hospice in the Grimsel Pass is situated, Dr. Wallace sees an example of the effects of a kind of eddy in old ice-streams flowing in nearly opposite directions. The celebrated Aarschlucht, one of the most remarkable gorges in Europe, is from 200 to 300 feet deep, and only about six feet in width. This is held to represent "the result of the action of sub-glacial torrents acting throughout the whole period during which the area was buried in ice. Thus only are we able to explain the fact of the almost uniform narrowness of the gorge from bottom to top, since during the process of its formation the rock walls would be preserved from ordinary denuding agencies, and be kept at a nearly uniform temperature." This view of the origin of the gorge is held by Prof. Bonney and by other geologists who have considered the subject, though the conclusions to which it leads differ. A number of other gorges in Switzerland are similarly explained. Accepting this interpretation, it is evident that gorges of this character ought only to be found in regions which have been recently glaciated. "In our own country," says Dr. Wallace, "we have many small gorges of this character, in Wales, the Lake District, and Scotland, that of Dungeon Gill, in Westmoreland, being an example; but more are to be found in decidedly non-glaciated areas, such as Devonshire, though narrow ravines are common enough. So in the Northern United States there are many such gorges, the Ausible Chasm in the Adirondacks, and Watkin Glen, near Seneca Lake, are well-known tourist resorts; but in the Southern States, beyond the glaciated area, there are no similar gorges, although the southern Alleghenies are loftier than farther north, and contain much grand and picturesque mountain scenery and many waterfalls and deep ravines, but these are all of the rugged and weathered type." In the mountainous region of Brazil, where there has certainly been no recent glaciation, Prof. Branner testifies that none of the characteristic sub-glacial stream channels occur. Finally, the gorges of the Aar, and others of like nature, are shown to afford evidence in favour of the theory of the glacial origin of the Swiss valley lakes. The abrupt Kirchet Hill, which extends across the valley of the Aar, is adduced by Prof. Bonney as an argument against this theory. "This would be a valid objection," says Dr. Wallace, "if the Aar glacier had continued in a straight, or nearly straight, line to Meiringen; but the influx of a large glacier stream from the north-east must have so diverted that of the Aar, that the resultant flow would have been across the lower valley, and almost along the steep face of Kirchet instead of directly across it. This would have been the case, because the glacier stream from the north-east was not only equal in size to that of the Aar valley, but had a more rapid descent, and, therefore, a quicker flow. In the last five miles the Aar valley has a fall of about 1500 feet, while the two north-eastern valleys have an average fall of about 2000 feet; and they are also much wider, which would still further facilitate rapidity of outflow."

Dr. C. M. Aikman gives in the *Contemporary* an account of the inoculation of agricultural land with pure cultures of bacteria, in the form of Nitragin, for the purpose of promoting plant-growth. A note on this advance in the science of agriculture will be found on page 326. To the same review Mr. Andrew Lang contributes a budget of records of the rite of "Passing through the Fire," beginning with the earliest accounts of this or some analogous ceremony, and concluding with the most recent authenticated contemporary examples. The rite is very widely diffused, and there is a considerable amount of evidence that the fire-walking is actually practised without apparent injury. In a few villages in Turkey, on the Bulgarian frontier, a festival is held in May, and certain persons still go through the performance of treading and dancing on the red-hot embers of a pile of wood, apparently without sustaining injury. Mr. Lang appeals to men of science to take up the subject, both on account of the widely-diffused religious character of the ceremony, and in order to discover how, granting the facts, the feat is performed. A scientific observer who would go to Bulgaria on May 21 next year, and thoroughly investigate the rite there, noting the state of the fire, the condition of the feet of the ministrants before and after the performance, and photographing the scene, would obtain some definite and valuable information.

A brief mention must suffice for the remaining articles on scientific topics in the magazines received by us. The second part of an historical study, by Mr. J. F. Hewitt, entitled "How the first Priests, the long-haired Shamans, and their successors, the tonsured Barber-surgeons, measured Time," appears in the *Westminster Review*. The article contains many facts of interest as to the origin of the year in the northern and southern hemispheres. The *Century* publishes some glimpses of life in Africa, from the journals of the late Mr. E. J. Glave, who completed his remarkable journey across Africa from east to west in May 1895, and died while waiting for the departure of the homeward steamer. The *Strand Magazine* has a detailed account of the balloon, accessories, and plan of Mr. Andrée, for his aërial polar expedition. There is also a liberally illustrated account of the methods and results of Röntgen photography, by Mr. Alfred W. Porter, in the same magazine. An instructive article on "Atmospheric Pressure" is contributed to *Longman's Magazine* by Mr. H. Harries. Articles of a like character appear in *Chambers's Journal* on "The Glastonbury Lake-Dwellers," and "Work in Compressed Air."

THE REPRODUCTION OF DIFFRACTION GRATINGS.[1]

I HAVE first to apologise for the very informal character of the communication which I am about to make to the club; I have not been able to put anything down upon paper, but I thought it might be interesting to some to hear an account of experiments that have now been carried on at intervals for a considerable series of years in the reproduction—mainly the photographic reproduction—of diffraction gratings. Probably most of you know that these consist of straight lines ruled very closely, very accurately, and parallel to one another, upon a piece of glass or speculum metal. Usually they are ruled with a diamond by the aid of a dividing machine; and in late years, particularly in the hands of Rutherfurd and Rowland, an extraordinary degree of perfection has been attained. It was many years ago—nearly twenty-five, I am afraid—that I first began experiments upon the photographic reproduction of these divided gratings, each in itself the work of great time and trouble, and costing a good deal of money. At that time the only gratings available were made by Nobert, in Germany, of which I had two, each containing about a square inch of ruled surface, one of about 3000 lines to the inch, and the other of about 6000. It happened, accidentally, that the grating with 3000 lines was the better of the two, in that it was more accurately ruled, and gave much finer definition upon the solar spectrum; the 6000-line grating was brighter, but its definition was decidedly inferior; so that both had certain advantages, according to the particular object in view.

If it comes to the question of how to make a grating by photography, probably the first idea to occur to one would be that it might be a comparatively simple matter to make a grating upon a large scale, and then reduce it by photography; but if one goes into the figures, the project is not found so promising. Take, for instance, a grating with 10,000 lines to the inch; if you magnified that, say, 100 times, your lines would then be 100 to the inch; if you magnified it 1000 times, they would still be 10 to the inch, and that would be a convenient size, so far as interval between the lines was concerned; but think what would be the area required to hold a grating magnified to that extent. By the time you have magnified the inch by 100 or 1000, you would want a wall of a house or of a cathedral to hold the grating. If the problem were proposed of ruling a grating with 6000 lines to the inch, with a high degree of accuracy, it would be easier to do it on a microscopic scale than upon a large scale, leaving out of consideration the difficulty of reproducing it. And those difficulties would be insuperable, because, although with a good microscopic object-glass it would be easy to photograph lines which would be much closer together than 3000 or 6000 to the inch, yet that could only be achieved over a very small area of surface—nothing like a square inch; and if it were required to cover a square inch with lines 6000 to the inch, it would be beyond the power, not only, I believe, of any microscope, but of any lens that was ever made. So that that line of investigation does not fulfil the promise which at first it might appear to give; and, in fact, there is nothing simpler or better than to copy the original ruled by a dividing engine, by the simple process of contact printing.

For this purpose some precautions are required. You must use very flat glass, by preference it should be optically worked, although very good results may be obtained on selected pieces of ordinary plate. Of course, no one would think of making such a print by diffused daylight; but the sun itself, or a point of light from any suitable source, according to the nature of the photographic process which is adopted, permits quite well of the reproduction of any grating of a moderate degree of fineness. I have used almost all varieties of photographic processes in my time. In the days when I first worked, the various dry collodion processes were better understood than they are now; the old albumen process was extremely suitable for such work as this, on account of the almost complete absence of structure in the film, and the very convenient hardness of the surface, which made the finished result comparatively little liable to injury. I used with success the dry collodion processes, the tannin process among others, and also some of the direct printing methods, such as the collodio-chloride. The latter method, worked upon glass, gave excellent results, particularly if the finished print was treated with mercury in the way commonly used for intensification, except that, in the treatment of a grating with mercury, it is desirable to stop at the mercury, and not to go on to the blackening process used in the intensification of negatives. From the visual point of view, the grating, after intensification—if one may use the term—with mercury, looks much less intense than before, but, nevertheless, the spectra seen when a point or slit of light is looked at through the grating become very much more brilliant.

I used another process at that time, more than twenty years ago, which gave excellent results, but had not the degree of certainty that I aimed at, namely, a bichromated gelatine process, similar to carbon printing, except that no pigment was employed. A glass plate was simply coated with bichromated gelatine of a suitable thickness—and a good deal depended upon hitting that off correctly; if the coating was too thin the grating showed a deficiency of brightness, whereas, if it was too thick, there might be a difficulty in getting it sufficiently uniform and smooth on the surface. However, I obtained excellent gratings by that process, most of them capable of showing the nickel line between the two well-known sodium or D lines in the solar spectrum, when suitably examined. The collodio-chloride process was comparatively slow, and bichromated gelatine required two or three minutes' exposure to sunlight to produce a proper effect; but for the more sensitive developed negative processes a very much less powerful light or a reduced exposure was needed.

The performance of the copies was quite good, and, except where there was some obvious defect, I never could see that they were worse than the originals; in fact, in respect of brightness it not unfrequently happened that the copies were far superior to the originals, so that in many cases they would be more useful. I do not mean by that, however, that I would rather have a copy than an original if any one wanted to make me a present. There seems to be some falling off in copies; so that they cannot well be copied again, and if you want to work upon spectra of an extremely high order, dispersed to a great extent laterally from the direct line, a copy would not be satisfactory. The reproduction of gratings on bichromated gelatine is easily and quickly accomplished; there is only the coating of the glass over-night, rapid drying to avoid crystallisation in the film, exposure, washing, and drying. In order to get the best effect it is usually desirable to treat the bichromated copies with hot water. It is a little difficult to understand what precisely happens. All photographers know that the action of light upon bichromated gelatine is to produce a comparative insolubility of the gelatine. In the carbon process, and many others in which gelatine is used, the gelatine which remains soluble, not having been sufficiently exposed to light, is fairly washed away in the subsequent treatment with warm water; but for that effect it is generally necessary to get at the back of the gelatine film, because on its face there is usually a layer which is so insoluble as not to allow of the washing away of any of the gelatine to be found behind. But in the present case there is no question of transferring the film, which remains fixed to the glass, and therefore it is difficult to see how any gelatine could be dissolved out. However, under the action of water, the less exposed gelatine no doubt swells more than that which has received more exposure and has thus lost its affinity for water; and while the gelatine is wet it is reasonable that a rib-like structure should ensue, which is what would be required in order to make a grating, but when the gelatine dries, one would suppose that all would again become flat, and indeed that happens to a certain extent. The gratings lose a great deal of intensity in drying, but, if properly treated with warm water, the reduction does not go too far, and a considerable degree of intensity is left when the photograph is dry.

Although it belongs to another branch of the subject, a word may not be out of place as to the accuracy with which the gratings must be made. It seems a wonderful thing, at first sight, to rule 6000 lines to an inch at all, if you think of the smallest interval that you can readily see with the eye, perhaps one-hundredth of an inch, and remember that in these gratings there are sixty lines in a space of one-hundredth of an inch, and all disposed at rigorously equal intervals. Those familiar with optics will understand the importance of extreme accuracy if I give an illustration. Take the case of the two sodium lines in the spectrum, the D lines; they differ in wave-length by about a thousandth part; the dispersion—the extent to which the light is separated from the direct line—is in proportion to the wave-length of the light, and inversely as the interval between the consecutive lines on the grating; so that, if we had a grating

[1] An address delivered by Lord Rayleigh at the eighth annual conference of the Camera Club.

in which the first half was ruled at the rate of 1000 to the inch, and the second half at the rate of 1001 to the inch, the one half would evidently do the same thing for one soda line as the other half of the grating was doing for the other soda line, and the two lines would be mixed together and confused. In order, therefore, to do anything like good work, it is necessary, not only to have a very great number of lines, but to have them spaced with most extraordinary precision; and it is wonderful what success has been reached by the beautiful dividing machines of Rutherfurd and Rowland. I have seen Rowland's machine at Baltimore, and have heard him speak of the great precautions required to get good results. The whole operation of the machine is automatic; the ruling goes on continuously day and night, and it is necessary to pay the most careful regard to uniformity of temperature, for the slightest expansion or contraction due to change of temperature of the different parts of the machine would bring utter confusion into the grating and its resulting spectrum.

In printing, the contact has to be pretty close, and the finer the grating the closer must the contact be. I experimented upon that point by preparing a photographic film upon a slightly convex surface, and using that for the print; then, where the contact was closest, the original of course was very well impressed, and round that, one got different degrees of increasingly imperfect contact, and one could trace in the result what the effect of imperfect contact is. I found that, both with gratings of 3000 and 6000 lines to the inch, good enough contact was obtained with ordinary flat glass; but when you come to gratings of 17,000 or 20,000 lines to the inch the contact requires to be extremely close, and in order to get a good copy of a grating with 20,000 lines per inch it is necessary that there should nowhere be one ten-thousandth of an inch between the original and the printing surface—a degree of closeness not easily secured over the entire area. It is rather singular that though I published full accounts of this work a long time ago, and distributed a large number of copies, the process of reproducing gratings by photography did not become universally known, and was re-discovered in France, by Isarn, only two or three years since.

One reason why photographic reproduction is not practised to a very great extent is, that the modern gratings—such as Rowland's—are ruled almost universally upon speculum metal. A grating upon speculum metal is very excellent for use, but does not well lend itself to the process of photographic copying, although I have succeeded to a certain extent in copying a grating ruled upon speculum metal. For this purpose the light had to pass first through the photographic film, then be reflected from the speculum metal, and so pass back again through the film. Gratings such as could easily be made by copying from a glass original are not readily produced from one on speculum metal, and I think that is the reason why the process has not come into more regular use. Glass is much more trying than speculum metal to the diamond, and that accounts for the latter being generally preferred for gratings; indeed, the principal difficulty consists in getting a good diamond point, and maintaining it in a shape suitable for making the very fine cut which is required.

I may now allude to another method of photographic reproduction which I tried only last summer. It happened that I then went with Prof. Meldola over Waterlow's large photo-mechanical printing establishment, and I was very much interested, among many other very interesting things, in the use of the old bitumen process—the first photographic process known. It is used for the reproduction of cuts in black and white. A carefully cleansed zinc plate is coated with varnish of bitumen dissolved in benzole, and exposed to sunlight for about two hours under a negative, giving great contrast. Where the light penetrates the negative the bitumen becomes comparatively insoluble, and where it has been protected from the action of light it retains its original degree of solubility. When the exposed plate is treated with a solvent, turpentine or some solvent milder than benzole, the protected parts are dissolved away, leaving the bare metal; whereas the parts that have received the sunlight, being rendered insoluble, remain upon the metal and protect it in the subsequent etching process. I did not propose to etch metal, and, therefore, I simply used the bitumen varnish spread upon glass plates, and exposed the plates so prepared to sunshine for about two hours in contact with the grating. They are then developed, if one may use the phrase, with turpentine; and this is the part of the process which is the most difficult to manage. If you stop development early you get a grating which gives fair spectra, but it may be deficient in intensity and brightness; if you push development, the brightness increases up to a point at which the film disintegrates altogether. In this way one is tempted to pursue the process to the very last point, and, although one may succeed so far as to have a film which is quite intact so long as the turpentine is upon it, I have not succeeded in finding any method of getting rid of the turpentine without leading to the disintegration of the film. In the commercial application of the process the bitumen is treated somewhat brutally—the turpentine is rinsed off with a jet of water; I have tried that, and many of my results have been very good. I have also tried to sling off the turpentine by putting the plate into a kind of centrifugal machine; but by either plan the film in which the development has been too far pushed, is liable not to survive the treatment required for getting rid of the turpentine. If the solvent is allowed to remain we are in another difficulty, because then the developing action is continued and the result is lost. But if the process is properly managed, and development stopped at the right point, and if the film be of the right degree of thickness, you get an excellent copy. I have one here, 6000 lines to the inch, which I think is about the very best copy I have ever made. The method gives results somewhat superior to the best that can be got with gelatine; but I would not recommend it in preference to the latter, because it is very much more difficult to work unless some one can hit upon an improved manipulation.

I will not enlarge upon the importance of gratings; those acquainted with optics know how very important is the part played by diffraction gratings in optical research, and how the most delicate work upon spectra, requiring the highest degree of optical power, is made by means of gratings, ruled on speculum metal by Rowland. I suppose the reason why no professional photographer has taken up the production of photographic gratings, is the difficulty of getting the glass originals; they are very expensive, and I do not know where they are now to be obtained. It seems a pity that photographic copies should not be more generally available. I have given a great many away myself; but educational establishments are increasing all over the country, and for the purpose of instructing students it is desirable that reasonably good gratings should be placed in their hands, to make them familiar with the measurements by which the wave-length of light is determined.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

MR. STANLEY DUNKERLEY has been appointed to the University Demonstratorship of Mechanism and Applied Mechanics at Cambridge, made vacant by the election of Mr. Dalby to the Professorship of Mechanical Engineering at Finsbury College.

AMONG the recipients of honorary degrees, conferred at the close of the summer session of the University of Edinburgh on Saturday, were Prof. Francis A. Walker, President of the Massachusetts Institute of Technology, and Sir Dietrich Brandis, K.C.I.E., F.R.S., late Inspector-General of Forests in India.

DR. J. B. PORTER, of Columbia College, New York, has been appointed to the newly-founded Macdonald chair of Mining and Metallurgy in the M'Gill University, Montreal. Mr. Herbert W. Umney, of Bath, has been appointed Assistant-Professor of Civil Engineering.

THE Council of the Hartley Institution, Southampton, have just made the following appointments:—Lecturer in Mathematics, Dr. Cuthbert E. Cullis, Assistant Lecturer to Prof. Karl Pearson, University College, London. Lecturer in Chemistry, Dr. D. R. Boyd, Demonstrator and Assistant Lecturer in Chemistry, Mason College, Birmingham. Lecturer in Biology and Geology, Mr. E. T. Mellor, Assistant Demonstrator in Biology, Owens College, Manchester.

HER MAJESTY'S Commissioners for the Exhibition of 1851 have made the following appointments to Science Research Scholarships, for the year 1896, on the recommendation of the authorities of the respective Universities and Colleges. The scholarships are of the value of £150 a year, and are ordinarily tenable for two years (subject to a satisfactory report at the end of the first year) in any University at home and abroad, or in some other institution approved of by the Commissioners. The

scholars are to devote themselves exclusively to study and research in some branch of science, the extension of which is important to the industries of the country. The nominating institutions and the scholars are as follows:—University of Glasgow, W. C. Henderson; University of Aberdeen, A. Ogg; Mason College, Birmingham, T. S. Price; University College, Bristol, E. C. Fortey; Yorkshire College, Leeds, H. M. Dawson; University College, Liverpool, H. E. Annett; University College, London, J. E. Petavel; Owens College, Manchester, J. L. Heinke; Durham College of Science, Newcastle-on-Tyne, J. A. Smythe; University College, Nottingham, G. B. Bryan; University College of Wales, Aberystwyth, S. W. Richardson; University College of North Wales, Bangor, D. Williams (conditional appointment); Queen's College, Galway, J. Henry; University of Toronto, A. M. Scott; Dalhousie University, Halifax, Nova Scotia, D. McIntosh; University of New Zealand, J. A. Erskine.

The following scholarships granted in 1895 have been continued for a second year on receipt of a satisfactory report of work done during the first year:—

Nominating institution.	Scholar.	Places of study.
University of Glasgow.	W. Stewart.	Universities of Glasgow and Berlin.
University of St. Andrews.	H. C. Williamson.	Marine Laboratories, Naples and Kiel.
University College, Dundee.	J. Henderson.	Polytechnicum, Munich.
University College, Liverpool.	J. T. Farmer.	MacDonald Engineering Laboratories, Montreal.
University College, London.	E. Aston.	University College, London, and University of Geneva.
Durham College of Science, Newcastle-upon-Tyne.	A. L. Mellanby.	MacDonald Engineering Laboratories, Montreal, and Durham College of Science.
University College, Nottingham.	M. E. Feilmann.	Polytechnicum, Zürich.
Queen's College, Belfast.	W. Hanna.	Laboratory of Royal College of Physicians and Surgeons, London, and Bacteriological Institute, Prague.
McGill University, Montreal.	R. O. King.	MacDonald Engineering Laboratories, Montreal. (To change for second year.)
Queen's University, Kingston, Canada.	T. L. Walker.	University of Leipzig.
University of Sydney.	J. A. Watt.	Royal College of Science, South Kensington.
University of New Zealand.	E. Rutherford.	Cavendish Laboratory, University of Cambridge.

A limited number of the scholarships are renewed for a third year when it appears that the renewal is likely to result directly in work of scientific importance. The following scholarships granted in 1894 have been renewed for a third year:—

Nomina g institution.	Scholar.	Places of study.
Universi of Edinburgh.	J. C. Beattie.	Universities of Vienna and Berlin.
University of Aberdeen.	W. B. Davidson	Universities of Würzburg and Leipzig.
University College, Liverpool.	Dr. A. J. Ewart	University of Leipzig and Botanical Institute, Java.
University of Toronto.	Dr. F. B. Kenrick.	University of Leipzig.

GENEROUS gifts to educational institutions in America have often been noted in these columns. The New York *Critic* has collected some valuable information concerning the total amounts of such gifts and legacies received from various benefactors. Perhaps the following summary of these encouragements will create a spirit of emulation in the wealthy men of the British Isles before whom it may come. George Peabody, various, £1,035,000. Stephen Girard, Girard College, present value about £3,000,000. John D. Rockefeller, University of Chicago, £1,485,200; Vassar College, £20,000; Barnard College, £5000. Miss Helen Culver, University of Chicago, £205,000. Leland Stanford, Leland Stanford Junior University, from £3,000,000 to £4,000,000. Johns Hopkins, Johns Hopkins University, over £600,000. John C. Green, Princeton College and Lawrenceville School, £600,000. Anthony J. Drexel, Drexel Institute, £600,000. Asa Packer, Lehigh University, 115 acres of land and £500,000. Charles Pratt, Pratt Institute, £540,000; Charles M. Pratt, £8000. Leonard Case, Case School of Applied Science, £400,000. Henry W. Sage, Cornell University, £234,000. Cornelius Vanderbilt (deceased), Vanderbilt University, £200,000; William H. Vanderbilt, £92,000; Cornelius Vanderbilt, £8000. Peter Cooper and his family, Cooper Union, £330,189. Paul Tulane, Tulane University, £210,000. Seth Low, Columbia University, £200,000; Barnard College, £2000. Washington C. De Pauw, De Pauw University, £200,000. James Lick, University of California, £150,000. Isaac Rich, Boston University, £140,000. Ezra Cornell, Cornell University, £134,000. J. Pierpont Morgan, New York Trade School, £100,000. Colonel and Mrs. Richard T. Auchmuty, New York Trade School, £82,000. The total of this list, which is probably not complete, amounts to £15,080,389.

SCIENTIFIC SERIALS.

Symons's Monthly Meteorological Magazine, July.—The "International Cloud Atlas." Mr. Symons takes the opportunity offered by the publication of this work (of which only a very few copies have yet been distributed) to make a brief reference to the principal works on clouds which have recently preceded the present one, including M. Weilbach's "Nordeuropas Skyformer" (Copenhagen, 1881), the "Wolken-Atlas" of MM. Hildebrandsson, Köppen, and Neumayer (Hamburg, 1890), M. Singer's "Wolkentafeln" (Munich, 1892), "Classificazione delle nubi" by the Specola Vaticana, containing some excellent reproductions of M. Mannucci's photographs (Rome, 1893), and the Rev. W. Clement Ley's "Cloudland" (London, 1894). The "International Cloud Atlas" (Paris, 1896) has been prepared under the superintendence of the International Meteorological Committee, and contains twenty-eight coloured reproductions of clouds. Although none of them is from an English photograph, Mr. Symons thinks our countrymen may be well content to see how largely the international system of 1896 is based upon the work of Luke Howard, and that the classification adopted is practically that of the joint work of Dr. Hildebrandsson and the Hon. Ralph Abercromby.—The spring drought of 1896. Mr. Symons selected twenty-eight stations distributed over the United Kingdom; these show that the rainfall for the first half of the year at eight out of sixteen English and Welsh stations, the total fell below two-thirds of the average, the lowest values being 48 per cent. at Haverfordwest; while for the Scotch and Irish stations the average was 83 per cent. and 80 per cent. respectively. The results for April and May show that at three stations the rainfall was less than 20 per cent. of the average, the total in London being 19 per cent. In 1893 the drought was more severe in parts of England and Wales, but the 1896 drought in the south of Ireland appears to be unprecedented; at Cork it lasted for sixty-four days.

THE numbers of the *Bulletino della Società Botanica Italiana* for May-July contain, in addition to papers of more local interest, one by Prof. G. Arcangeli on the elongation of the organs of aquatic plants (chiefly *Nymphæaceæ*), in which he expresses the opinion that the stress due to the weight of the superposed liquid is the chief stimulus for their adaptation to the depth of the water in which they live. The same author has a note on the sleep of plants, and the benefits which they derive from the varying positions of the leaves by night and by day.

THE contents of the *Nuovo Giornale Botanico Italiano* for July comprise four papers, of which the titles only can be given:—The conclusion of Sig. L. Nicotra's exhaustive essay on the statistics of the Flora of Sicily; Sig. A. Lenticchia on morphological variations in wild and cultivated plants; Sig. F. Tasci on the mycology of the Province of Sienna; Sig. U. Martelli on a new species of *Centaurea* (*C. ferulacea*).

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 18.—"The Determination of the Freezing-point of Mercurial Thermometers." By Dr. J. A. Harker.

The method adopted is to cool distilled water in a suitable vessel to a temperature below 0°, to insert the thermometer,

and then bring about the freezing of the water by dropping in a crystal of ice. The thermometer then rises, and finally attains a steady temperature, differing only very slightly from the true zero.

The apparatus employed consists of two portions, the thermostat and the cooler. The former is a copper vessel, filled with either refined petroleum or a strong solution of common salt. This vessel communicates with the cooler, through which the liquid can be pumped by a rotary stirrer; and by this means it can be cooled and maintained for some time at about $-2°$. The distilled water to be frozen is contained in a glass tube of about 300 c.c. capacity. This is first placed directly into the circulating liquid, and cooled quickly to $-0·5°$ or $-0·7°$. It is then transferred to a cylinder lined with polished metal, placed in the centre of the thermostat. The thermometer whose zero is to be taken is then quickly fixed in position, the bulb and a considerable length of the stem above the zero being immersed in the water. A crystal of ice is dropped in, and the temperature quickly rises to the freezing point.

Experiments made with good mercurial thermometers showed that if ice be present in sufficient quantity, the final temperature attained by the mixture of ice and water is not influenced perceptibly by variation of the temperature of the circulating liquid within fairly wide limits. As, however, it seemed desirable to control this result by some other means, a platinum thermometer and bridge were designed, capable of indicating with certainty a change of $0·0001°$, and a description of the whole arrangement employed to attain this degree of accuracy forms the second half of the paper. The resistances in the bridge were of manganin, and the thermometers were provided with the compensating leads, devised by Mr. Callendar. The maximum current which can be used in accurate measurements with these thermometers is about 0·02 ampere, and therefore the galvanometer employed required to be extremely sensitive. The instrument selected was a low resistance astatic one with vertical needle system, and gives at the greatest working sensibility one scale division for 1×10^{-10} ampere.

With this arrangement the influence of various conditions on the final temperature attained by the mixture of ice and water was studied. The results were found to be in close agreement with the theoretical deductions of Nernst, and it was quite easy to keep the temperature in the freezing vessel constant to within one or two ten-thousandths of a degree for an hour at a time.

The conclusion drawn from the previous experiments made with mercurial thermometers as to the small influence of changes in the external temperature, and in the temperature of the circulating liquid on that of the freezing vessel, was also confirmed, and it was found that a change of two or three degrees in the temperature of the circulating liquid only caused the temperature of the mixture in the tube to alter by three or four ten-thousandths.

EDINBURGH.

Royal Society, July 20.—The Hon. Lord M'Laren in the chair.—Prof. Tait gave a brief description of a paper by Lord Kelvin on the different configurations possible with the same law of force according to Boscovich. In previous papers the author had confined himself to a treatment of the nature of configuration. This paper was a daring application of principle towards a rational explanation of crystalline form, having regard to the mutual forces involved.—Prof. Ludwig Boltzmann's communication, read by Prof. Tait, on the importance of Clerk-Maxwell's contributions to the kinetic theory of gases, consisted of a few sentences setting forth the writer's high respect for Clerk-Maxwell, and defining his relations with M. Bertrand. The paper in full was promised later.—Dr. Halm read an abstract of his paper on theoretical researches on the daily change of the temperature of the air. The fundamental differential equations of the problem, so far as they concern the curve of temperature during night, were first propounded by A. Weilenmann, in his essay, "Ueber den taeglichen Gang der Temperatur zu Bern" (*Schweizerische Meteorol.*, Beobachtungen ix., 1872), which may be considered as the first successful attempt at investigating the question from a theoretical point of view. But the physical explanation of his mathematical terms being insufficient, the author undertakes to show that these equations are in perfect agreement with the fundamental laws of radiation and conduction of heat, as given by Fourier and many others. The general question, by what means does the lowest layer of the atmosphere, the temperature of which is recorded by our thermometric instruments, receive or lose heat, may be answered by this result. Every change of temperature is caused by continuous radiation between the soil and an unknown part of the atmosphere—for which, however, there can be substituted, under all circumstances, two masses of air with the same coefficient of radiation, one of these having the variable temperature of the observed lowest layer; the other, a constant temperature. The next part of the paper consisted in proving that Weilenmann's equations, by a proper application of the sun's radiating power at every moment during the day, can be used for deriving an integral which gives expression to the change of the temperature during the time from sunrise to sunset. This integral consists of two different parts, one of which contains two arbitrary constants, naturally involved by the process of integration; the others are functions of time introduced by the law of solar radiation on a horizontal surface. But it can easily be proved that both the arbitrary constants have to disappear in every case, so that the change of temperature appears to be regulated simply by functions directly depending on the radiating power of the sun. Considering the fact that the conditions of radiation must be importantly influenced by various systematical disturbances, such as convection currents, the continuous change of the quantity and quality of atmospheric moisture, the state of cloudiness and the physical conditions of the soil, great importance has to be laid on the question how these may be given expression to in the fundamental equations of the problem. As far as the convection currents are concerned, their influence is shown to be in perfect agreement with observations, the range of temperature being diminished, and the time of maximum being brought nearer to the culmination of the sun when the direction of the current is from a cold quarter; the opposite being the case when from a warm one. The effect of sea-breezes is an example of the former condition; that of currents flowing from a mountain to the valley during daytime, an example of the latter. The very considerable effect of the daily change in the amount of atmospheric moisture, which has been deduced from direct observation of clouds and the absolute humidity of the air, complicates the theoretical equation by adding a new term, the parameters of which can be shown to be in full agreement with these observations. The most important branch of the subject treated in the paper was the determination of the solar constant from the *daily* temperature observations, which, after the influence of the state of cloudiness and the change of the physical conditions of the soil therefrom resulting, have been investigated, show values sufficiently accurate to admit of examining the question of the periodicity of solar radiation by a method the advantages of which seem obvious compared with the commonly used method founded on study of mean *annual* temperatures. From a large number of stations in Austria and Hungary, whose observations, extending over the years 1876–93, have been used, the author shows a close correspondence between the inverted curve of sun-spots and that of solar radiation. A much fuller investigation, however, extending over a longer series of years, and embracing a greater extent of territory, is required to finally establish the results deduced.—Prof. J. M. Dixon, of St. Louis, described in an interesting and popular manner the tornado which recently visited that city, and of which he was an eye-witness. The report already given in NATURE (vol. liv. p. 104) he characterised as correct.—Mr. Robert Kidston read a paper describing some cones of *Sigillarii*, in which the structure of the sporangia was shown. The sporangia appeared to be immersed in the bracts in a somewhat similar manner to that which occurs in *Isoetes* showing that the affinities of *Sigillarii* are with *Isoetes*, as conjectured by Goldenberg. Two new species of Sigillarian cones (*Sigillariostrobus*) were described, and a new species of *Sigillaria*.—Prof. Charteris read a short paper on the physiological action of eucaine. He claimed for this new antiseptic, which he described merely as a compound synthetically prepared, that it was not so toxic as cocaine, while the anæsthesia it produced was as complete. It did not contract the pupil when applied to the eye, and a solution in water did not decompose.—The Chairman, in a few words, reviewed the work of the past session, and held out hopes of further prosperity and usefulness in the future.

PARIS

Academy of Sciences, July 27.—M. A. Cornu in the chair.—On the water-spout of July 26, at the Museum of Natural History, by M. Milne-Edwards. An account

of the disastrous effects upon the Museum produced by this water-spout.—On some new experiments relating to the preparation of the diamond, by M. H. Moissan.—Study of the black diamond, by the same. Black diamond, reduced to a very fine state of division, and heated in a stream of oxygen to a temperature about 200° C. below the temperature of combustion of the diamond, gives off a very small amount of carbon dioxide, and the diamond remaining is transparent.—A Spanish truffle and three new truffles from Marocco, by M. Ad. Chatin. The new specimens are described as *Terfezia Mellerionis*, of Laroche, *Terfezia Leonis* (var. *heterospora*), of Laroche, and *Terfezia Boudieri*, of Mazogan.—On the homogeneity of argon and helium, by Prof. W. Ramsay and J. Norman Collie. By fractional diffusion through porous tubes, argon yields two portions, of which the lighter has a density of 19·93, the heavier of 20·01. Similar experiments with helium gave densities of 1·874 and 2·133 for the two extreme portions, results which were confirmed by measurements of the refractive indices by Lord Rayleigh. Both specimens gave spectra which were absolutely identical, and hence the possibility is suggested of there being here a true separation of light molecules from heavy molecules of the same substance.—On the mononitrile of camphoric acid, its anhydride and anilide, by MM. A. Haller and Minguin.—On a method for giving the exact direction of a sound signal, by M. E. Hardy. Two methods are given for effecting this at sea.—Note accompanying two memoirs on thermochemistry, by M. Langlois.—On the error of refraction in geometric levelling, by M. Ch. Lallemand. It is shown that the effect of the refraction of the air, which can generally be neglected or eliminated in triangulation, becomes quite appreciable in levelling, and a formula is developed for introducing the necessary correction.—On the distribution of the displacements in metals subjected to stresses, by M. G. Charpy. The suggestion of M. Hartmann that metals, in spite of their known heterogeneous structure, behave as homogeneous bodies, has been submitted to further experiments, with the result that the displacements vary from point to point, and correspond in all respects with the structure shown micrographically.—On the density and mean specific heat between 0° and 100° of the alloys of iron and antimony, by M. J. Laborde. The numbers found for the specific heats are all greater than those calculated from the assumption of simple mixture.—On the determination of the ratio of the specific heats of gases, by MM. G. Maneuvrier and J. Fournier. The final results are: for air 1·392, for carbon dioxide 1·299, for hydrogen 1·384.—Researches on the relations existing between the radiation of a body and the nature of the surrounding medium, by M. Smoluchowski de Smolan. An experimental study of the formula of Clausius, according to which the emission should be proportional to the square of the refractive index of the medium. The general result is to confirm the law of Clausius.—Cranial endography by means of the Röntgen rays, by MM. Remy and Contremoulins.—Study of the nitrogen and argon of fire-damp, by M. Th. Schlœsing, jun. Specimens of fire-damp collected with suitable precautions from many sources all contained nitrogen, showing a notable amount of argon; the ratio of argon to nitrogen was, within the limits of experimental error, about the same as in air.—On the preparation of selenic acid, by M. R. Metzner. This acid is readily obtained by oxidising dilute solutions of selenious acid with free permanganic acid.—On a new cobaltite, by M. E. Dufau. By heating magnesia and cobalt sesquioxide in the electric furnace a crystallised magnesium cobaltite, $MgCoO_3$ is obtained.—On the solutions of trichloracetic acid, by M. Paul Rivals. A thermochemical study of the dissociation of trichloracetic acid in solution.—On vinyl-trimethylene and ethylidene-trimethylene, by M. G. Gustavson.—On the constitution of pinacoline, by M. Maurice Delacre.—Crystallographic properties of some alkyl-camphors of the aromatic series, by M. J. Minguin.—Formation and etherification of crotonylic alcohol, by M. E. Charon.—On the electrolysis of the fatty acids, by M. J. Hamonet.—On several modes of preparation of the blue nitrosodisulphonic acid and its salts, by M. Paul Sabatier.—New observations on *Clythra quadripunctata*, by M. A. Lécaillon.—Influence of the reaction of the medium upon the activity of the oxidising ferment of mushrooms, by M. E. Bourquelot.—On a cellulose filter, by M. Henri Pottevin. A description of a cellulose filter capable of taking the place of the biscuit porcelain filter. Owing to the cheapness of material, instead of the cleaning process necessary for porcelain, a new disc can be used.—The mechanism of the extension of the blastoderm, and its relation to the eye of the fish, by M. E. Bataillon.—On the presence in the superior laryngeal nerve of secretory and vasculo-motor fibres for the mucous membrane of the larynx, by M. E. Hédon.—On the physiological significance of direct cellular division, by MM. E. G. Balbiani and F. Henneguy.—Study of the gizzard in some *Blattidæ* and *Gryllidæ*, by M. Bordas.—The constitution of the phosphates of lime from Tunis, by M. L. Cayeux.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Books.—The Student's Handbook of British Mosses: H. N. Dixon and H. G. Jameson (Eastbourne, Sumfield).—The G. E. R. Co.'s Tourist Guide to the Continent (London).—A Text-Book of Physical Exercises: Dr. A. H. Carter and S. Bott (Macmillan).—La Distillation des Bois: E. Barillot (Paris, Gauthier-Villars).—Monthly Current Charts of the Indian Ocean (London).—Catalogue of the Described Diptera from South Asia: F. van der Wulp (Nijhoff, Hague).

Pamphlets.—Peabody Institute 29th Annual Report (Baltimore). Symbolism in American Art: F. W. Putnam and C. C. Willoughby (Salem, U.S.A.).

Serials.—Astronomical Observations and Researches made at Dunsink, 7th Part (Dublin, Hodges).—Longman's Magazine, August (Longmans).—Chambers's Journal, August (Chambers).—Proceedings of the Aristotelian Society, Vol. 3, No. 2 (Williams).—Proceedings of the Edinburgh Mathematical Society, Vol. xiv. (Williams).—L'Anthropologie, tome vii. No. 3 (Paris, Masson).—Good Words, August (Isbister).—Sunday Magazine, August (Isbister).—Humanitarian, August (Hutchinson).—Contemporary Review, August (Isbister).—National Review, August (Arnold).—Physical Review, Vol. 4, No. 1. (Macmillan).—Bulletin de l'Académie Royale des Sciences de Belgique, 1896, No. 6 (Bruxelles).—Journal of the Institution of Electrical Engineers (Spon).—Journal of the Chemical Society, (Gurney).—Century, August (Macmillan).—Scribner's Magazine, August (Low).—Notes from the Leyden Museum, Vol. xviii. No. 1 (Leyden, Brill).—Fortnightly Review, August (Chapman and Hall).—Westminster Review, August (Warne).—Ornithologist, August (Bale).—Gazetta Chimica Italiana (Rome).—Revue Générale des Sciences, July (Paris).—Memoire della Spettroscopisti Italiani, July (Rome).—Bulletin de la Société d'Encouragement, July (Paris).

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